



BATTLE OF BRITAIN SERIES · PAN BOOKS/MACDONALD

William Green

AIRCRAFT OF THE BATTLE OF BRITAIN



*Aircraft of
The Battle of Britain*

William Green

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Contents

Preface

PART ONE

The Defenders

The Hawker Hurricane	7
The Supermarine Spitfire	13
The Boulton Paul Defiant	19
The Bristol Blenheim IF	24

PART TWO

The Attackers

The Messerschmitt Bf 109	27
The Messerschmitt Bf 110	34
The Junkers Ju 87	41
The Junkers Ju 88	47
The Heinkel He 111	53
The Dornier Do 17 and Do 215	59

Preface

TODAY, all but a score and ten years since the epic aerial conflict of all time was fought out in the skies above the Channel and southern England by R.A.F. Fighter Command and the *Luftwaffe* of Germany's Third Reich, mere mention of the Battle of Britain still possesses the power to stir the imagination; to evoke vivid mental images of the struggle on the outcome of which the fate of Britain rested.

All too often the pictures conjured up must depict a handful of debonair young men gaily clambering into Spitfires to take on with studied nonchalance a numerically superior if technically inferior and less skilful enemy. Somewhat less glamorous are the images recalled by those of us who witnessed or participated in the "Battle"; who can still hear the tortured whine of the over-revving engine, the spasmodic chatter of machine guns and the dull coughing of cannon, and can still see in the mind's eye the weaving contrails and the pyre of pilot and fighter that have flown their last sortie.

The Battle of Britain was a battle of attrition in which neither side conceded and which left both sides battered and exhausted. Neither combatant enjoyed any corner in competent, courageous and determined pilots. A few of both sides were pre-eminent, and the stories of their exploits were to be told and re-told; the majority were humble and unknown. But the principal actors in the drama that unfolded in those summer and autumn months of 1940 were the warplanes that came to grips in British skies. Each possessed its intrinsic merits, each its shortcomings, and it is this cast that is described and illustrated in the pages that follow.

WILLIAM GREEN

Part One

THE DEFENDERS

The Hawker Hurricane

As Sydney Camm and his team laboured over the detail design of their new fighter monoplane in Hawker Aircraft's drawing offices in Canbury Park Road, Kingston-upon-Thames, on the outskirts of London, in those early summer months of 1934, they could scarcely have foreseen the enormity of the responsibility that would be vested in their creation, the magnitude of the task that six years later it would be called upon to perform, or the odds by which it would be faced.

This warplane, whose prototype trials were to commence some eighteen months later, on November 6, 1935, eight miles away at Brooklands, was to achieve immortality as the Hurricane. The synthesis of years of fighter biplane design translated into the modern formula, and a compromise between tradition and the requirements born of a new era in aerial warfare, the Hurricane was destined to carry much of the burden of Britain's defence during that most significant of conflicts fought out above southern England in the fateful summer and autumn of 1940—the Battle of Britain.

Whereas the Hurricane was the logical outcome of a long line of fighting aircraft, the Spitfire, with which it was to establish so historic and successful a partnership, was an entirely new conception based on specialized experience. The two fighters met broadly the same requirements but represented entirely different approaches to their fulfilment. This was reflected to some degree in their respective appearances—the Hurricane workmanlike, rugged and sturdy, and the Spitfire, slender and ballerina-like. One was the studied appli-

cation of experience, the other a stroke of genius, and in British skies they were to complement one another to a remarkable degree.

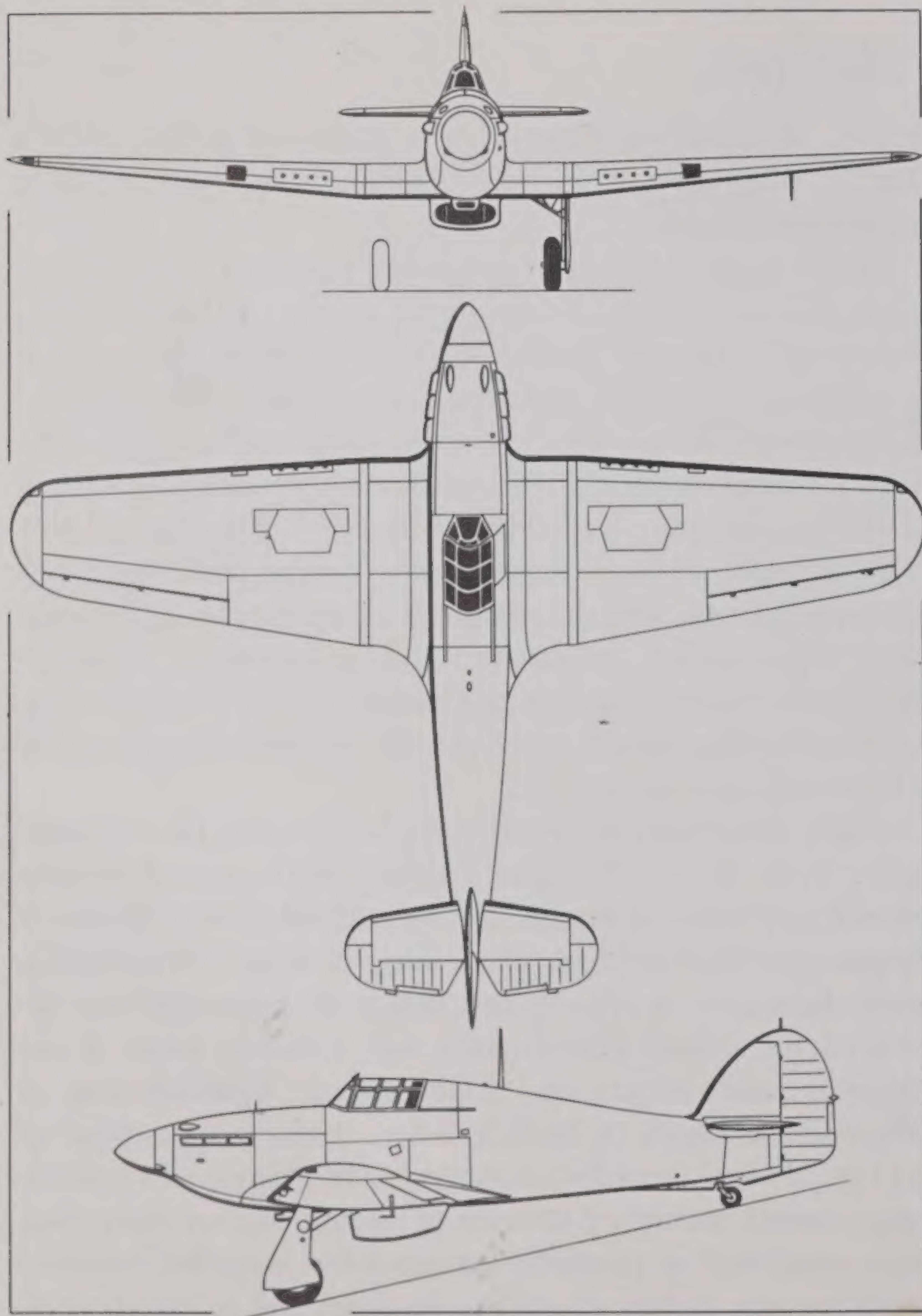
For its era the Hurricane was aerodynamically an extremely clean aircraft. Perhaps surprisingly, in view of the growing vogue of light-metal stressed-skin monocoque structures, it coupled its advanced aerodynamics and such ultra-modern features as a fully-retractable undercarriage and enclosed cockpit with classic tubular metal construction and fabric covering, following the pattern established by earlier Hawker fighters. This retention of fabric skinning was viewed with misgivings in some quarters and the design of metal stressed-skin wings was begun before prototype trials commenced, although these were not to appear on production machines before 1939, and the fuselage was to remain fabric covered throughout the Hurricane's production life.

Flight trials with the prototype, which were the responsibility of P. W. S. "George" Bulman, were marred by only minor problems, although the new Rolls-Royce Merlin C engine provided its share of teething troubles. Nevertheless, only three months after its first flight, the prototype was delivered for official performance and handling trials to the Aircraft and Armament Experimental Establishment at Martlesham Heath in Suffolk where a maximum speed of 315 m.p.h. was recorded at 16,200 ft., an altitude of 15,000 ft. was attained within 5.7 minutes of unstick, and service ceiling was established as 34,500 ft. Service pilots were well satisfied with the new fighter's handling qualities, and in March 1936,

The Hawker Hurricane

confident that quantity production orders were imminent, Hawker Aircraft began preparation of draft production schedules on its own initiative.

The company's confidence in its fledgeling was not mis-



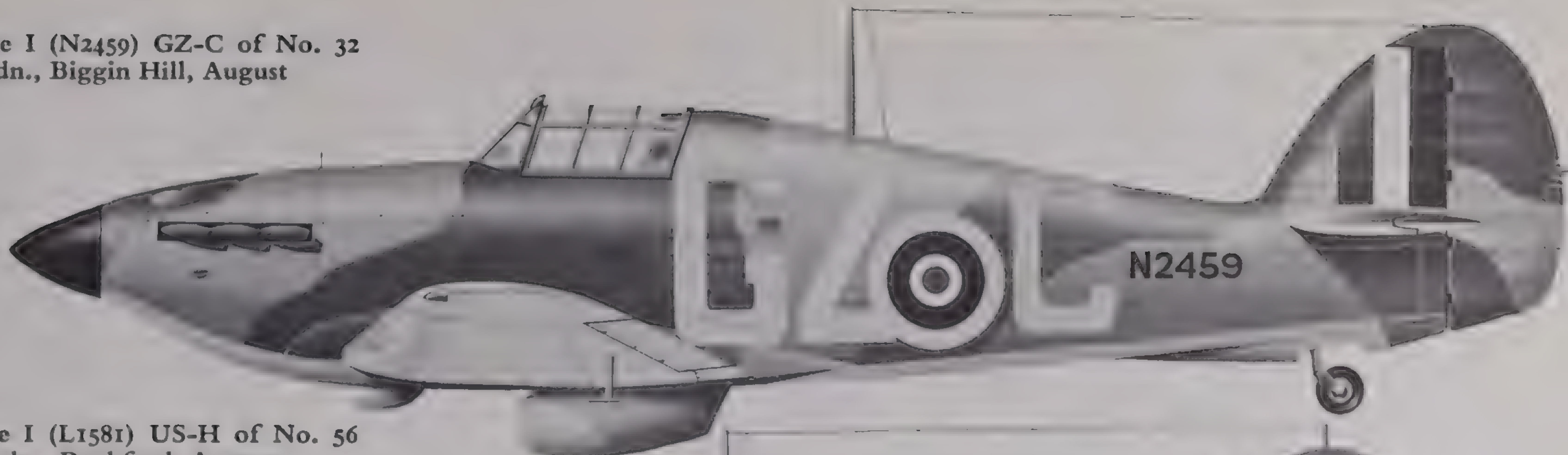
placed for on June 3rd an order was received for no fewer than 600 Hurricanes—the largest single production order for a military aircraft issued in Britain since World War One. Within a week production drawings had begun to reach the shops, although some delay resulted from the decision to adopt the Merlin II engine, and it was not until 16 months later, on October 12, 1937, that the first production Hurricane was flown from Brooklands. The second followed six days later, seven having flown by the end of November.

By Christmas of 1937, No. 111 Squadron at Northolt had taken four Hurricanes on strength, completing re-equipment in February 1938, and as production tempo built up—from six aircraft per week in March to eight per week by late summer—further squadrons discarded their obsolete biplanes in favour of the new Hawker fighter. Eighteen squadrons were to be Hurricane-mounted by September 3, 1939.

The first production machines were entirely fabric covered, and lacked such refinements as armour and bullet-proof windscreen. Their Merlin II engine, rated at 1,030 h.p. at 16,250 ft. and driving a Watts fixed-pitch wooden two-bladed airscrew, endowed them with a maximum speed of 318 m.p.h. at 17,400 ft., an initial climb rate of 2,050 ft./min. increasing to 2,450 ft./min. at 11,000 ft., and a service ceiling of 33,400 ft. A total of 2,660 rounds of ammunition was provided for their eight 0.303-in. Browning guns which, initially harmonised to converge at 650 yards, were destined to have their harmonisation range progressively shortened to 200 yards.

Before the Hurricane had been blooded in combat over France changes were already being embodied in the fighter to improve its combat effectiveness. An armoured bulkhead had been introduced forward of the cockpit, and when Hawker Aircraft's second production batch began leaving the assembly line in September 1939 a bullet-proof windscreen had been standardised. This batch also adopted the Merlin III engine,

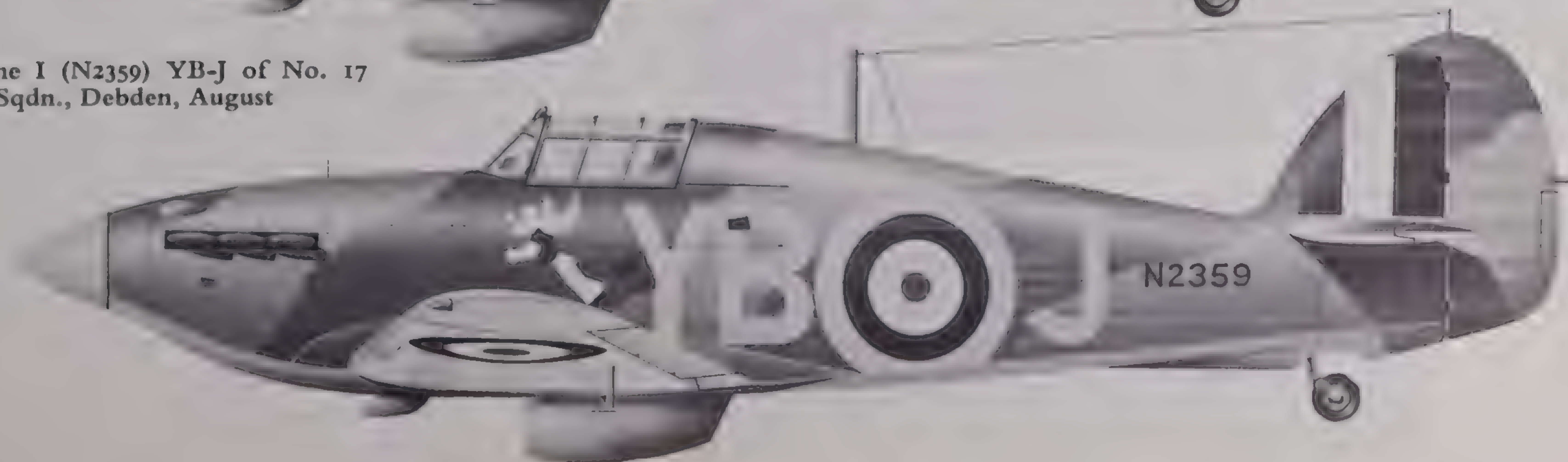
Hurricane I (N2459) GZ-C of No. 32
Sqn., Biggin Hill, August



Hurricane I (L1581) US-H of No. 56
Sqn., Rochford, August



Hurricane I (N2359) YB-J of No. 17
Sqn., Debden, August





(Above) Hurricane I (P3408) of No. 85 Sqdn. at Martlesham and (left) a Hurricane I of No. 32 Sqdn. at Kenley

the last Hurricanes with fabric-covered wings and wooden fixed-pitch airscrews would be withdrawn from operational squadrons, but the heavy attrition suffered in the continental débâcle of May and June dictated the re-issue of many of the older machines, although few remained on strength when R.A.F. Fighter Command and the *Luftwaffe* joined battle in earnest in British skies in August.

The fighting in France took grievous toll of the R.A.F.'s Hurricanes, and between May 10th and June 20th 386 Hurricanes were lost. Alarming though this loss in aircraft was it could be made good rapidly from new production—total Hurricane deliveries for June alone being 309 machines. It was the loss of many experienced pilots at a time when the arrival of newly-trained pilots with the squadrons was barely more than a trickle that was *really* disastrous. R.A.F. Fighter Command had hardly more than a month to prepare itself for a battle unprecedented in the annals of warfare; a battle on the outcome of which depended Britain's fate.

On July 7, 1940 the R.A.F. Fighter Command Order of

which, while affording a similar power output to that of its predecessor, featured a shaft capable of taking either Rotol or de Havilland three-bladed constant-speed airscrew. With the 81st Hurricane of the second batch the fabric-covered wing finally gave place to an all-metal stressed-skin wing, and on February 2, 1940 the first Hurricane with rear armour protection for the pilot was flown.

It had been anticipated that, during the course of May 1940,

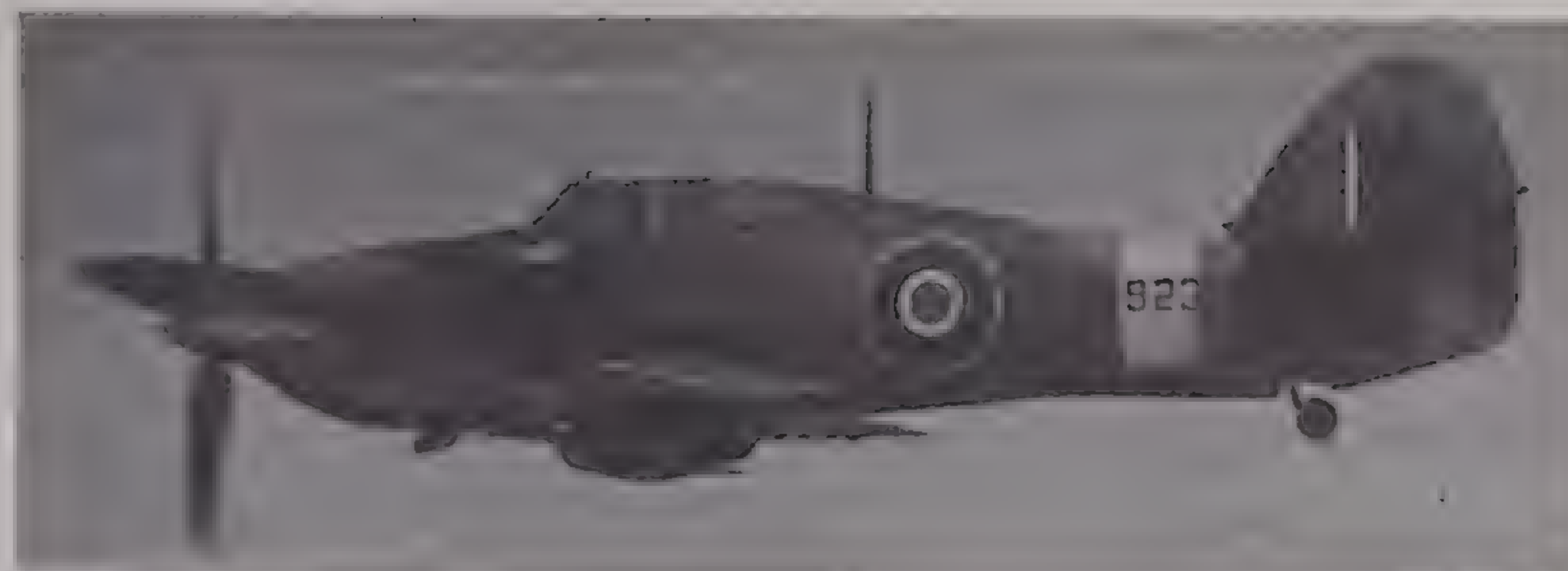
The Hawker Hurricane

Battle comprised 50 squadrons of which half (Nos. 1, 3, 17, 32, 43, 46, 56, 79, 85, 87, 111, 145, 151, 213, 229, 238, 242, 245, 249, 253, 257, 501, 504, 601 and 615 squadrons) were operating Hurricanes. One month later, on August 8, 1940, five days before what *Reichsmarschall* Hermann Göring had designated *Adlertag*, or "Day of Eagles", that was to mark the opening of the Battle of Britain proper, the number of Hurricane squadrons in the Order of Battle had been increased to 28 (Nos. 73, 232, 605 and 607 squadrons having achieved operational status and No. 79 Squadron having converted from Hurricanes to Spitfires) from a total of 55 squadrons of which 19 were mounted on the Spitfire. The total Fighter Command establishment was 1,588 aircraft but actual strength was only some 1,400 machines, with combat-ready reserves in storage units comprising 160 Hurricanes and 132 Spitfires.

Before battle was joined the fact that the Hurricane was inferior in most performance respects to its principal German opponent, the Messerschmitt Bf 109E, had been accepted. The Bf 109E was faster at all altitudes, and could out-climb and out-dive the Hurricane with ease. Thus, if the German pilot elected to break off the engagement the pilot of the Hurricane was powerless to pursue his erstwhile opponent. But in low-altitude manoeuvrability and turning circle at all altitudes the Hurricane had the upper hand, and provided the Bf 109E did not join combat with an altitude advantage the Hurricane was its match. Apart from its performance inferiority the Hawker fighter was not found wanting, and its sturdier structure enabled it to withstand battle damage that would have rendered its antagonist *hors de combat*.

The Hurricane's admitted shortcomings in performance compared with that of the Bf 109E led to it being allocated,

(Right) A Hurricane I (W9232) of Gloster's third main production batch, delivered too late to join the "Battle"





in theory at least, the primary task of dealing with the *Luftwaffe* bomber formations which seldom operated much above 16,000–17,000 ft., the faster-climbing Spitfires keeping the escorting Bf 109Es occupied. Admirable though this plan undoubtedly was, in the heat of battle it proved rarely possible to co-ordinate the attacks of both Hurricane and Spitfire formations in this fashion, and all too frequently Hurricanes intercepting a bomber formation were promptly attacked from above by escorting Bf 109Es.

By September 30, 1940, when the Battle of Britain entered its final phase, 448 Hurricanes had been lost in combat since the beginning of August and a further 144 had suffered damage but were repairable. Including those destroyed or damaged on the ground by enemy action and accidental casualties, the two months had seen the permanent or temporary loss to strength of 696 Hurricanes, and production of new aircraft over this period had totalled 503 machines, yet, while the number of Spitfire squadrons in R.A.F. Fighter Command's Order of Battle had remained static, Hurricane-equipped squadrons had increased in number to 31, these including a Canadian, a Czechoslovak and two Polish units.

The battle was by no means over but its climax had passed, and far from being worn down by the constant assault of the *Luftwaffe*, as Göring fondly hoped, the strength of R.A.F. Fighter Command was undiminished. Despite the deterioration of the weather as October progressed the *Luftwaffe* persisted in its attacks, and the Hurricane, because of its numerical superiority over the Spitfire, continued to shoulder the

largest portion of the burden of Britain's defence. From early September the Hurricane I had been supplemented by the Hurricane IIA Series 1, which, having a two-stage supercharged Merlin XX engine affording 1,260 h.p. at 11,750 ft. and 1,160 h.p. at 20,750 ft., markedly reduced the performance edge previously enjoyed by the Bf 109E, attaining 342 m.p.h. at 22,000 ft. and reaching an altitude of 20,000 ft. in 8.2 minutes.

With the end of October came the end of the Battle of Britain. During the course of the month the Hurricane squadrons had suffered in combat some 240 aircraft lost or damaged, but this fighter, born on the drawing boards in Canbury Park Road, Kingston-upon-Thames, six years earlier, had acquitted itself well. Despite a performance disadvantage in fighter-versus-fighter combat, it had proved to be a fine fighting vehicle by any standard, affording an excellent gun platform and superlative manoeuvrability.

Hawker Hurricane I Specification

Type:	Single-seat Fighter.
Power Plant:	One Rolls-Royce Merlin III 12-cylinder liquid-cooled engine rated at 880 h.p. for take-off, 990 h.p. at 12,250 ft., and 1,030 h.p. at 16,250 ft.
Performance:	Maximum speed, 254 m.p.h. at sea level, 324 m.p.h. at 15,650 ft.; range cruising speed, 190 m.p.h. at 15,000 ft.; maximum range, 505 mls., (with 20 min. reserves), 425 mls.; initial climb rate, 2,300 ft./min.; climb rate at 11,000 ft., 2,420 ft./min.; time to 15,000 ft., 6.5 min., to 20,000 ft., 9.8 min.; service ceiling, 34,200 ft.
Weights:	Empty, 4,982 lb.; normal loaded, 6,447 lb.
Armament:	Eight 0.303-in. Browning Mk. II machine guns with 334 r.p.g.
Dimensions:	Span, 40 ft. 0 in.; length, 31 ft. 4 in.; height, 12 ft. 11½ in.; wing area, 258 sq. ft.

The Supermarine Spitfire

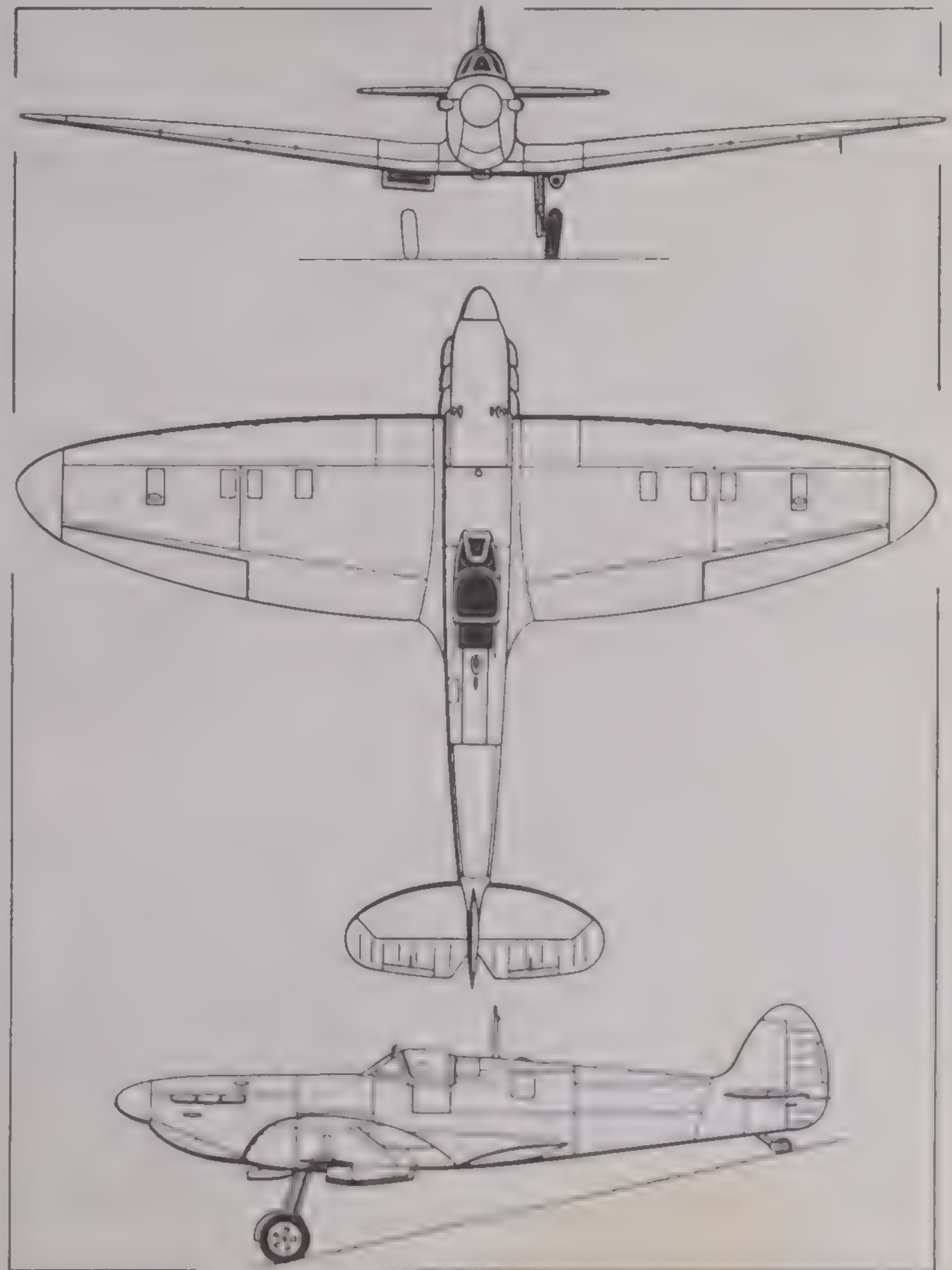
By November 1940 the Battle of Britain was over. Insofar as the R.A.F. was concerned this epic conflict had been fought out by the Hurricane and the Spitfire, the ratio of operational machines throughout the battle being roughly two to one in favour of the former, and their combat losses being proportionate. Yet, despite the numerical importance of the Hurricane, it was the Spitfire that was the material symbol of victory to the British people in their darkest hour. Indeed, the Spitfire was probably the only fighter of World War Two to achieve a truly legendary status.

The success that attended the Spitfire from its earliest days was no accident. It was both an inspired design *and* the outcome of a lengthy process of technical evolution. Its sires included the Supermarine S.6B which, in 1931, won the Schneider Trophy outright for Britain, going on to raise the world air speed record to 406.99 m.p.h., and in no warplane was evolution more clearly discernible than in the Spitfire. With such a distinguished pedigree nothing less than a true thoroughbred could have resulted.

Flown in prototype form for the first time on March 5, 1936 from Eastleigh airfield, Southampton, with J. "Mutt" Summers at the controls, the Spitfire was the end product of a process of development and refinement of a private-venture fighter design of Reginald J. Mitchell, chief designer of the Supermarine Aviation Works (Vickers) Limited. In essence, the Spitfire was the smallest practical warplane that could be designed around a pilot, the chosen power plant and the specified armament, and as such it provided an interesting parallel with what was to become its principal opponent in World War Two, the Messerschmitt Bf 109, the first prototype of which had flown some six months earlier at Augsburg-Haunstetten.

While the lines first evolved for the Schneider Trophy

racing floatplanes reappeared in the fuselage contours of the new fighter, the wing was of new elliptical planform, the aerodynamic advantages of which were considered to out-



weigh the production difficulties that it presented, and the result was aesthetically one of the most pleasing aircraft designs ever evolved. Unlike Sydney Camm, who chose to retain the classic steel-tube structure with fabric covering for his contemporary Hurricane, Reginald Mitchell elected to employ a light alloy monocoque fuselage and a single-spar metal stressed-skin wing as had also Dipl.-Ing. Messerschmitt working in Augsburg. Powered by a similar Merlin C engine to that mounted by the prototype Hurricane, the Spitfire rapidly proved itself to possess a maximum speed of 349.5 m.p.h. in level flight. Its controls were incredibly light and its powers of manoeuvre were superb.

Within two months of the prototype's maiden flight an order was placed with Supermarine for 310 production aircraft, this contract being issued on June 3rd simultaneously with Hawker Aircraft's contract for 600 Hurricanes. Supermarine's Woolston plant began preparations immediately for the construction of the fuselages, manufacture of the rest of the airframe being widely subcontracted, but late delivery of some of the subcontracted components was to result in some delay in service introduction of the Spitfire, and the R.A.F. was not to receive its first fighter of this type until August 4, 1938 when the third production Spitfire was ferried to No. 19 Squadron at Duxford.

By the beginning of 1939, production tempo had begun to build up, and by September 3rd nine squadrons—Nos. 19, 41, 54, 65, 66, 72, 74, 602 and 611—had completed conversion to the Spitfire, and two more, Nos. 603 and 609, were in process of conversion. Like the early Hurricanes, the first Spitfires off the assembly line had the Merlin II engine driving a two-bladed fixed-pitch wooden airscrew, and attained 352 m.p.h. at 19,000 ft., a maximum climb rate of 2,420 ft./min., and an altitude of 20,000 ft in 9.4 minutes. With the 78th production aircraft the wooden two-blader gave place to a de Havilland Hamilton two-pitch three-bladed metal air-

screw which, although incurring a weight penalty and having only a marginal effect on level speed, bestowed a significant improvement in the climb. No bullet-proof windscreen or armour was initially fitted, and although standard armament was envisaged as eight wing-mounted 0.303-in. Browning guns each with 300 rounds of ammunition, a shortage of these weapons led to the installation of only four guns in early machines. Later, with full Browning armament, the fighter became the Spitfire IA, and the introduction of a bullet-proof external windscreen was to be followed by provision of a 6-mm. armour plate behind the pilot's head.

Air Chief Marshal H. C. T. Dowding commanding R.A.F. Fighter Command had carefully husbanded his Spitfire squadrons throughout the fighting on the continent, but during the evacuation from Dunkirk home-based Spitfires provided air cover, and in May and June 69 Spitfires had been lost. On July 7, 1940 the R.A.F. Fighter Command Order of Battle included 18 Spitfire squadrons (Nos. 19, 41, 54, 64, 65, 66, 72, 74, 92, 152, 234, 266, 602, 603, 609, 610, 611 and 616), and these were soon involved in the preliminary skirmishing that preceded *Adlertag*.

Evaluation of a captured Bf 109E-3 fighter had already revealed the unpalatable fact that the German fighter was superior in a number of respects to the Spitfire with the two-pitch airscrew, and as priority in the supply of constant-speed units had been allocated to bombers virtually all Spitfires were fitted with such airscrews. The Messerschmitt fighter was marginally faster than its British contemporary at most altitudes, and it could out-climb the Spitfire up to 20,000 ft. above which the British fighter enjoyed an edge. Both fighters suffered some aileron heaviness at the upper end of their speed scale, and while the Spitfire possessed superior manoeuvrability at all altitudes as a result of its lower wing loading, turning circle being appreciably smaller, the Bf 109E could always elude the Spitfire in a dive, the float carburettor

The Supermarine Spitfire

Spitfire I (X4474) QV-I of No. 19 Sqn., Duxford,
August



Spitfire I (X4172) QJ-W of No. 92 Sqn., Pembrey,
September



Spitfire I (N3029) DW-K of No. 610 Sqn., Biggin
Hill, August





(Above top, and left) Spitfire Is of No. 92 Sqdn., (above) Spitfire Is of No. 610 Sqdn. patrolling from Biggin Hill, and (opposite page) Spitfires of No. 19 Sqdn., at Duxford.

of the British fighter's Merlin engine placing it at a distinct disadvantage.

With the 175th production Spitfire the Merlin II engine had given place to the Merlin III suitable for either the Rotol or de Havilland constant-speed airscrew, but it was not until late in June 1940 that field conversion of Spitfires with de Havilland constant-speed units began in earnest. The constant-speed airscrew improved climb rate and manoeuvrability and endowed the fighter with an appreciably better ceiling, largely redressing its performance shortcomings, and fortunately, by August 8th, *Adlertag*, the majority of the Spitfires on R.A.F. Fighter Command strength had been converted, and two-thirds of the 218 Spitfires that had rolled off the assembly lines

since the beginning of July had been delivered with constant-speed airscrews.

One more Spitfire unit, No. 222 Squadron, had been added to the Order of Battle to raise to 19 the number of squadrons mounted on this fighter at the start of the Battle of Britain proper. With the exceptions of Nos. 54, 65, 74 and 610 Squadrons in No. 11 Group and Nos. 602 and 603 Squadrons in No. 13 Group which, like the Hurricane squadrons, had an authorised establishment of 20 machines, these each had an establishment of 16 Spitfires. Two hundred and seven Spitfires were in storage units of which 118 were available for immediate issue.

Once R.A.F. Fighter Command had discarded its out-dated

The Supermarine Spitfire

tactics of which the *Luftwaffe's* Bf 109E fighters took full advantage during the opening phases of the battle, the Spitfire and its German opposite number proved remarkably evenly matched. Each possessed some characteristics superior to those of its opponent, and all things being equal, the outcome of a battle depended largely on the prowess of the pilots involved.

By the very nature of the conflict the *Luftwaffe's* losses in single-seat fighters were appreciably lower than those of R.A.F. Fighter Command, and the Spitfire squadrons alone lost 118 fighters in combat during August, a further 55 being damaged. Added to Spitfires lost or damaged in accidents or by enemy bombing 237 Spitfires were lost to strength during the course of the month, and total output of the factories engaged in Spitfire production comprised only 163 machines. Attrition in September was even more serious, 156 being

manufactured and 281 being lost to strength of which 130 were destroyed and 80 damaged in combat. But Fighter Command was never down to its last half-dozen Spitfires in reserve as was to be popularly believed, the lowest point in





reserves being reached in the week ending September 13th when only 47 Spitfires were ready for delivery in storage units.

During the course of the battle an improved version of the fighter, the Spitfire IIA, began to reach the squadrons, although relatively few were available until the winter by which time *Adlerangriff* had petered out. The Spitfire IIA retained the eight-gun armament of its predecessor but introduced a 1,175 h.p. Merlin XII engine which drove a Rotol constant-speed airscrew, and whereas the Spitfire IA had its armour added in service the IIA left the factory with armour installed. The Spitfire IIA attained a maximum speed of 357 m.p.h. at 17,000 ft., could attain an altitude of 20,000 ft. within seven minutes of unstick, maximum climb rate being 2,620 ft./min.

What the outcome of the Battle of Britain would have been had the Spitfire not been available to R.A.F. Fighter Command is purely of academic interest, but what is certain is the fact that no combat aircraft ever gave better service to the country of its birth.

A Spitfire I (P9450) of 4th production batch prior to R.A.F. acceptance

Supermarine Spitfire IA Specification

Type:	Single-seat Fighter.
Power Plant:	One Rolls-Royce Merlin III 12-cylinder liquid-cooled engine rated at 880 h.p. for take-off, 990 h.p. at 12,250 ft., and 1,030 h.p. at 16,250 ft.
Performance:	Maximum speed (at 5,820 lb.), 355 m.p.h. at 19,000 ft.; maximum cruising speed, 312 m.p.h. at 20,000 ft.; economical cruising speed, 205 m.p.h.; maximum range, 575 mls., (including allowance for take-off, climb and 15 min. combat), 395 mls.; maximum climb rate, 2,500 ft./min.; time to 15,000 ft., 6.2 min., to 20,000 ft., 9.4 min.; service ceiling, 34,000 ft.
Weights:	Empty equipped, 4,810 lb.; loaded, 5,820 lb.
Armament:	Eight 0.303-in. Browning Mk. II machine guns with 300 r.p.g.
Dimensions:	Span, 36 ft. 10 in.; length, 29 ft. 11 in.; height, 11 ft. 5 in.; wing area, 242 sq. ft.

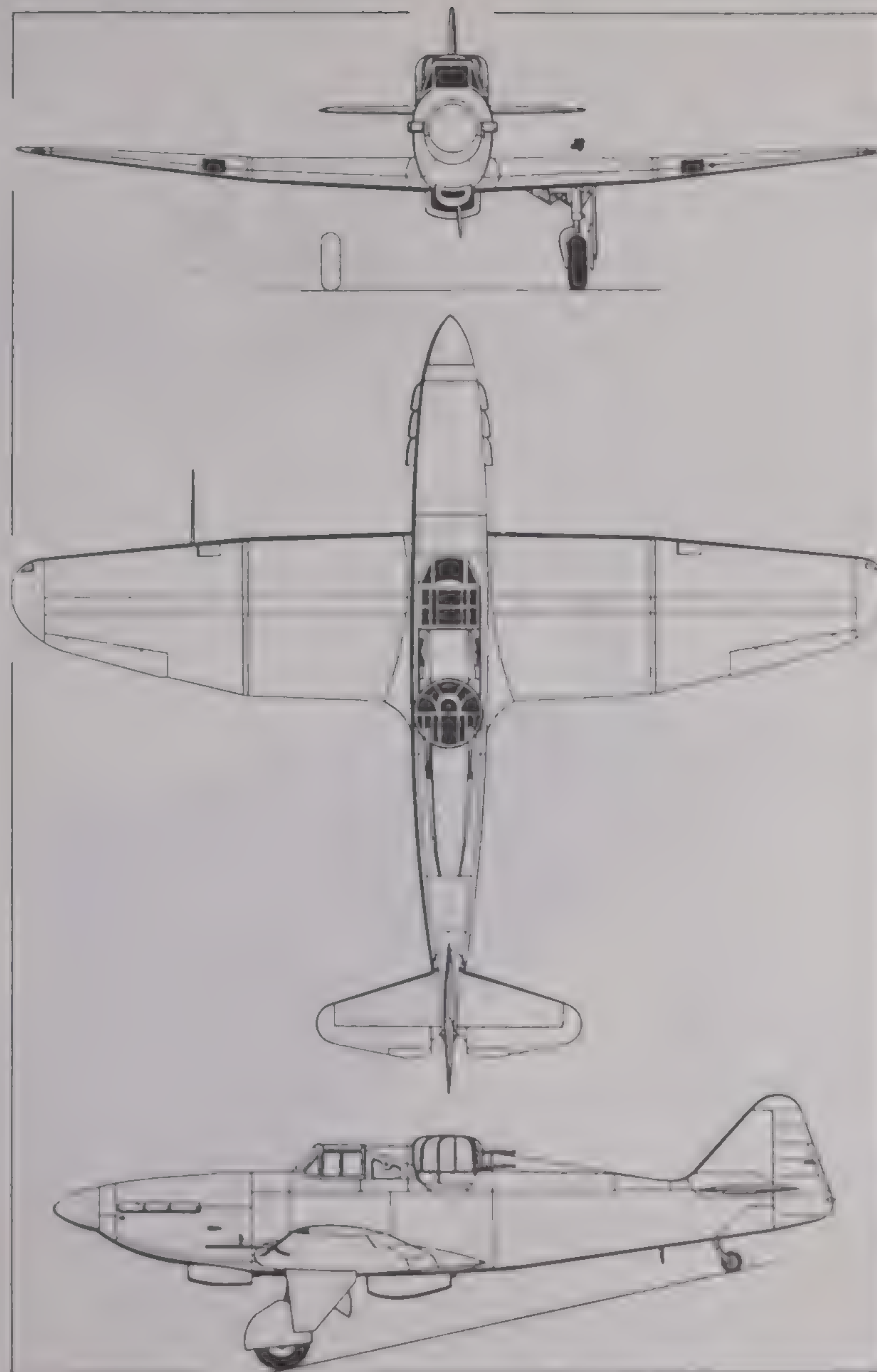
The Boulton Paul Defiant

WHILE the philosophy of the single-seat single-engined fighter mounting a battery of wing guns was to be proven tactically correct by the Battle of Britain, another concept that crystallised at much the same time, that of the two-seat single-engined fighter with all armament concentrated in a massive power-operated turret, proved a dismal failure, at least, insofar as daylight operations were concerned.

This unsuccessful concept was exemplified by the Defiant born of the belief that a gunner possessing no responsibility for flying the fighter, and having control of a battery of guns with a 360-degree traverse, had more chance of hitting the enemy than a pilot who had to point his aircraft in the direction in which he wished to fire. How fallacious was this belief was to be revealed all too forcibly during the opening phases of the Battle of Britain, but the failure of the Defiant was due to no shortcoming on the part of the Boulton Paul design team headed by J. D. North which more than fulfilled the requirements of the official specification.

No designer, however ingenious, could evolve a fighter handicapped by the weight and drag of a bulky powered turret yet capable of matching the agility and speed of contemporary single-seaters employing the same power plant, but the most serious error in the turret-armed two-seat fighter concept lay in the division of responsibility between pilot and gunner. Possessing no fixed forward-firing armament, the Defiant pilot had to think in abstract terms of his gunner's likely line of sight, and it was all too easy for an enemy fighter to creep in under cover of the blind spot beneath the tail and deliver the *coup de grâce*.

In the design of the Defiant the Boulton Paul team paid the closest attention to aerodynamic cleanliness in an attempt to compensate to some extent for the drag of the turret, and the result was an aircraft generally similar in overall size to the





Defiant Is of No. 264 Sqdn., at Kirton-in-Lindsey



Hurricane. Its all-metal structure was conventional in most respects, its only unusual feature being the method of attaching the light alloy skinning to the stringers and ribs and then attaching these to the fuselage frames and wing spars. This obviated the need to preform the skins, and by riveting them while flat and countersinking the rivets an exceptional surface finish was obtained.

The first prototype made its inaugural flight at Wolverhampton on August 11, 1937, with Boulton Paul's chief test pilot, Cecil Feather, at the controls. Initially flown as a single-seater with the turret "well" faired over and with ballast to compensate for the turret and its occupant, the prototype Defiant attained 302 m.p.h. on the power of its Merlin I engine, and its flying characteristics were pronounced excellent. It displayed very few vices, stability was highly satisfactory, and there was practically no change of trim when the undercarriage and flaps were lowered. A tendency

The Boulton Paul Defiant

to swing to port during take-off was easily corrected, and with flaps and undercarriage retracted one wing dropped to a vertical position when the aircraft was stalled, this usually developing into a gentle flick roll if the control column was held back.

An initial contract for 87 Defiants had been placed in March 1937, some five months before the commencement of flight testing, and production drawings began to reach the shops before the end of the year. The decision to supplant the Merlin I by the Merlin II engine which delayed production deliveries of the Hurricane also delayed completion of the second prototype Defiant but provided an opportunity to introduce various changes proposed for the production model, and this aircraft did not fly until May 18, 1939. It was followed closely by the first production example, which, flown on July 30th, was powered by the Merlin III, this power plant with its standardised shaft for either de Havilland or Rotol constant-speed airscrews having been selected as standard for the Defiant I.

During the previous year the initial production order had been supplemented by further contracts, 202 being ordered in February and 161 in May, and deliveries proceeded quickly after the first aircraft came off the line. Its Boulton Paul A.Mk.IID turret was a removable self-contained unit mounting four 0.303-in. belt-fed Browning guns each provided with

600 rounds, and its entire hydraulic system formed an integral part of the turret itself. The bare turret weighed 361 lb. to which was added the 88 lb. of the four guns, 106 lb. for ammunition, and some 35 lb. for the gunner's oxygen equipment, sights, etc. Normal loaded weight at 8,318 lb. was some 1,700 lb. more than that of the similarly-powered Hurricane, yet the gross wing area of the two-seater was less than that of the single-seater. It was hardly to be expected, therefore, that the Defiant would be able to compete on the score of level speed, climb rate or manoeuvrability.

Comparative trials between the Defiant and the Hurricane were undertaken by No. 111 Squadron at Northolt in October 1939, and in his report on the trials the Squadron's Commanding Officer gave it as his opinion that any average pilot flying a Hurricane could master an aircraft with the power/weight ratio of the Defiant, and that the Boulton Paul fighter would fare badly if it came up against a Bf 109 for a *second* time! He obviously considered the Defiant's philosophy to be outmoded, and his comments were to prove prophetic.

Despite the unfavourable results of the Defiant-versus-Hurricane trials, No. 264 Squadron formed at Sutton Bridge during the same month as the combat evaluation took place was designated the first unit to receive the Boulton Paul

Defiant I (N1535) PS-A of No. 264 Sqdn.,
Kirton-in-Lindsey, July



The Boulton Paul Defiant

fighter. After moving to Martlesham the unit received its first two Defiants on December 8, 1939, and despite failure to resolve satisfactorily the tactical problems presented by the fighter, on March 20, 1940 two sections of No. 264 Squadron were considered operational, moving two days later to Wittering from where convoy patrols were initiated. On May 10th the entire squadron was transferred to Duxford, and the Defiant drew first blood within two days when, operating from Horsham St. Faith with the Spitfires of No. 66 Squadron providing top cover, "A" Flight destroyed a Ju 88A in the vicinity of the Hague while patrolling along the Dutch coast.

On the next day Defiants of "B" Flight undertaking a similar patrol encountered a formation of Ju 87B dive

bombers, destroying four of the enemy. Unfortunately for the British fighters they were promptly "bounced" by escorting Bf 109Es which despatched five of the six Defiants. Offensive patrols were thereafter cancelled and the Defiant was largely restricted to the anti-bomber role over the channel, but the Boulton Paul fighter was still to enjoy its brief hour of glory on daylight operations.

Between the 27th and 31st of May the exigencies of the situation necessitated despatching No. 264 Squadron's Defiants across the channel to patrol above Dunkirk. During this period the squadron claimed 57 "kills" of which no fewer than 37 were claimed during the course of two patrols over Dunkirk on May 29th! The primary reason for this startling success was, according to the squadron's Commanding Officer, that "the enemy mistook us for Hurricanes". If this was so the *Luftwaffe* was not to make the same mistake again, but the claims, fully accepted at the time, were subsequently to prove considerably exaggerated. For example, on May 29th, the day on which No. 264 Squadron claimed 37 victims, the official *Luftwaffe* records were to show that only 14 aircraft were in fact lost in action.

At the time it appeared that the philosophy behind the Defiant's design had been vindicated, but the rapidity with which the *Luftwaffe* evolved the most effective means of



(Opposite page) Defiant Is of No. 264 Sqdn., and (right) an early production Defiant prior to delivery to the R.A.F. The Defiant's lack of success in combat with the single-seat fighters of the Luftwaffe reflected the failure of the philosophy behind its design



engaging the Defiant may be judged from the fact that, on May 31st, no less than seven of No. 264 Squadron's complement of fighters was lost. The combat-weary unit spent June and July working up again to squadron strength. In the meantime, on June 3rd, a second Defiant unit, No. 141 Squadron, had achieved operational status, and during the following month was transferred to Hawkinge for the defence of coastal targets. On July 19th nine of No. 141 Squadron's Defiants were "bounced" by Bf 109Es south of Folkestone, two of the two-seat fighters being lost in the first firing pass, and four more being lost when the German fighters made their second attack from below and dead astern, using the Defiant's blind spot.

This disastrous action led to the release of No. 141 Squadron from operations, the unit taking no part in the main phase of the Battle of Britain. The calamitous encounter between the Defiants of No. 141 Squadron and the Bf 109E provided but a foretaste of what was to befall the similarly-equipped No. 264 Squadron which, having moved South on August 22nd, was left with only three serviceable fighters within a week. It was at last appreciated that the concept of the turret-armed fighter had no place in the Battle of Britain. The pilot always had to think in terms of his gunner's firing arc and this was im-

practicable in the type of *mêlée* that was to be seen in the skies of southern England during that summer and autumn of 1940. Thus, the Defiant, which was to find its forte in nocturnal skies, was withdrawn from the battle.

Boulton Paul Defiant I Specification

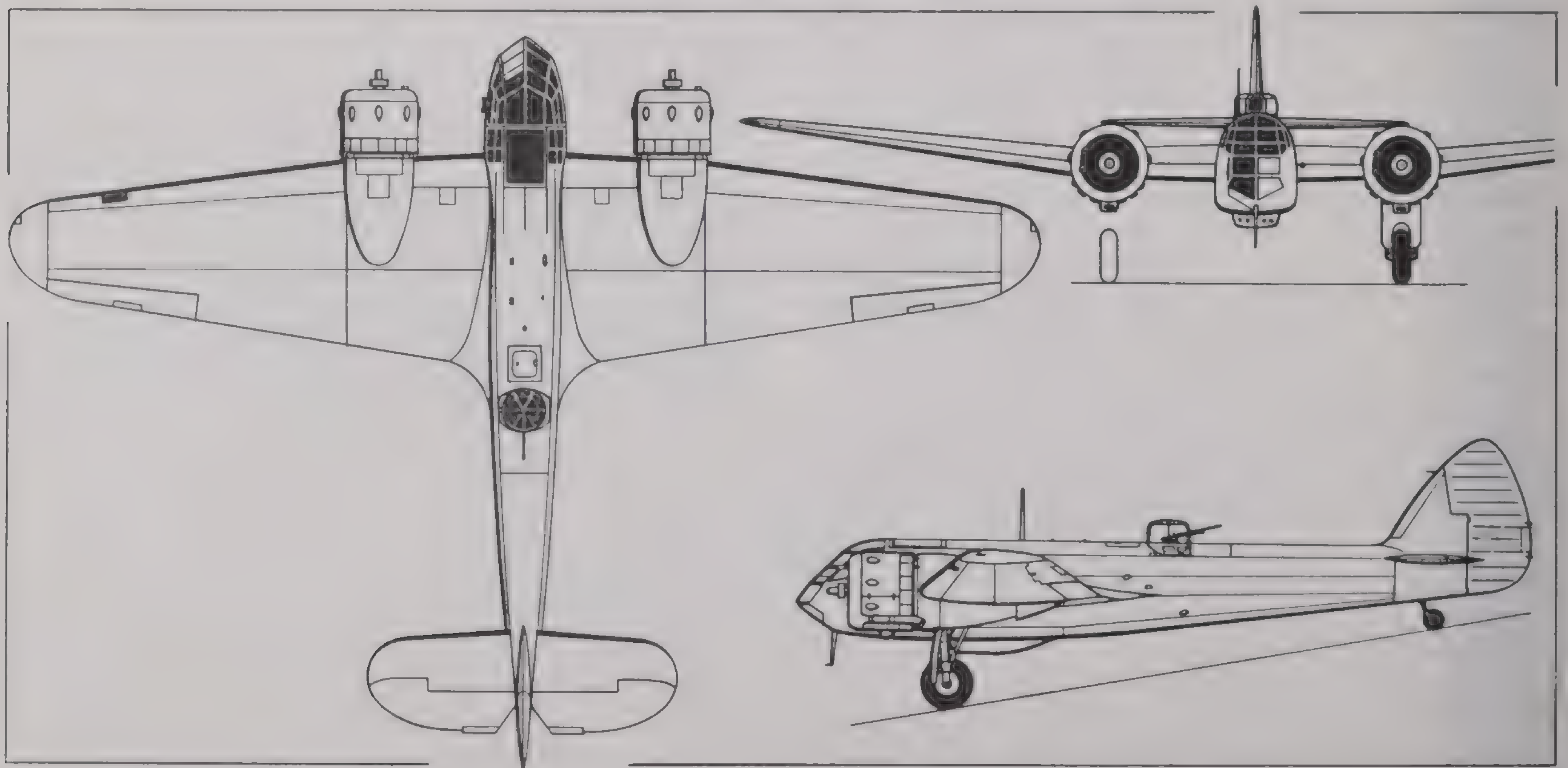
Type:	Two-seat Fighter.
Power Plant:	One Rolls-Royce Merlin III 12-cylinder liquid-cooled engine rated at 880 h.p. for take-off, 990 h.p. at 12,250 ft., and 1,030 h.p. at 16,250 ft.
Performance:	Maximum speed (at 8,318 lb.), 250 m.p.h. at sea level, 298 m.p.h. at 12,000 ft., 304 m.p.h. at 17,000 ft.; cruising speed, 259 m.p.h. at 15,000 ft.; range, 465 mls. at 259 m.p.h.; initial climb rate, 1,900 ft./min.; time to 15,750 ft., 8.5 min.; service ceiling, 30,350 ft.
Weights:	Empty, 6,078 lb.; normal loaded, 8,318 lb.; maximum permissible, 8,350 lb.
Armament:	Four 0.303-in. Browning machine guns with 600 r.p.g. in hydraulically-operated Boulton Paul A. Mk. IID turret.
Dimensions:	Span, 39 ft. 4 in.; length, 35 ft. 4 in.; height, 11 ft. 4 in.; wing area, 250 sq. ft.

The Bristol Blenheim IF

WHEN *Adlertag* dawned the Order of Battle of R.A.F. Fighter Command included six squadrons, Nos. 23, 25, 29, 219, 600 and 604, mounted on a fighter adaptation of the Blenheim day bomber which, when it had made its début four years earlier, had been immediately hailed as a major step forward in combat aircraft design. The fact that the Blenheim was already obsolescent by the beginning of World War Two reflects no short-sightedness on the part of Captain Frank Barnwell, Bristol's chief designer, but the extraordinary pace of combat aircraft evolution during those last two years of peace in Europe.

At the time of its service introduction the Blenheim possessed a performance enabling it to outpace most contemporary service aircraft in all categories, but that it was not the redoubtable weapon supposed was to be revealed early in the conflict. As a bomber it proved woefully vulnerable to fighter attack, being deficient in both defensive armament and armour, and it lacked the performance necessary for a fully effective strategic fighter, but it was all that was available, and it was destined to become one of the very few aircraft types to serve with *all* R.A.F. Commands.

The first all-metal cantilever monoplane of stressed-skin



The Bristol Blenheim IF



Blenheim IF (L1457) ZK-P of No. 25 Sqdn., Martlesham, August

Bristol Blenheim IF Specification

Type:	Three-seat Long-range Fighter.
Power Plants:	Two Bristol Mercury VIII nine-cylinder radial air-cooled engines each rated at 725 h.p. for take-off, 795 h.p. at 13,000 ft., and 840 h.p. at 14,000 ft.
Performance:	Maximum speed (at 12,240 lb.), 237 m.p.h. at sea level, 249 m.p.h. at 5,000 ft., 263 m.p.h. at 10,000 ft., 278 m.p.h. at 15,000 ft.; maximum cruising speed, 215 m.p.h. at 15,000 ft.; maximum range, 1,050 mls.; initial climb rate, 1,480 ft./min.; time to 5,000 ft., 3.9 min., to 10,000 ft., 8.1 min.; service ceiling, 24,600 ft.
Weights:	Empty, 8,840 lb.; loaded, 12,200 lb.
Armament:	Four 0.303-in. Browning machine guns with 500 r.p.g. in ventral pack, one 0.303-in. Browning with 400 rounds in wing, and one 0.303-in. Vickers "K" gun in Bristol B.I. Mk. III hydraulically-operated dorsal turret.
Dimensions:	Span, 56 ft. 4 in.; length, 39 ft. 9 in.; height, 9 ft. 10 in.; wing area, 469 sq. ft.

construction to be placed in production for the R.A.F., the Blenheim denoted the beginning of a new era in the equipment of the service after several years of acute uneasiness concerning the obsolescence of the R.A.F.'s operational aircraft inventory. It was a cornerstone of the expansion programme, and its conversion from three-seat light bomber to heavy fighter in 1938 was prompted by what was considered, by the standards of the day, a fully adequate performance coupled with sturdiness and excellent handling characteristics.

For the fighter role the Blenheim was adapted from the standard bomber simply by the addition of a ventral pack which, manufactured by the Southern Railway's Ashford workshops, housed a quartette of 0.303-in. Browning guns plus 500 rounds of ammunition for each weapon, this supplementing the normal armament of a single wing-mounted Browning and a Vickers "K" gun of similar calibre in a B.I. Mk. III semi-retractable hydraulically-operated dorsal turret. This conversion, designated Blenheim IF, had re-equipped or was in process of re-equipping seven fighter squadrons at the outbreak of war.



(Above) Blenheim IF of No. 25 Sqdn. based at Martlesham during the "Battle" with No. 11 Group, and (below) a Blenheim IF with A.I. Mk. IV radar, the first nocturnal "kill" with the aid of which was scored during the "Battle"



Early operational experience dictated the provision of a reflector sight, self-sealing tanks and some armour, and Blenheim IF fighters of No. 23 Squadron undertook the first night intruder sortie of the war on December 21-22, 1939, but the fact that the operation of the Blenheim fighter by day was suicidal in areas where enemy single-seat fighters were likely to be encountered in strength was made abundantly clear during the continental fighting of May and June 1940, and subsequently the Blenheim IF was restricted largely to nocturnal activities. On June 5th the *Luftwaffe* made its first night attack on London, and Blenheim IFs instituted a system of nocturnal patrols which, on June 18th, resulted in the destruction of five bombers by moonlight.

Meanwhile, the Blenheim IF had been closely involved in the development of airborne intercept radar. A flight of three aircraft of No. 600 Squadron operating from Manston had performed operational trials with A.I. Mk. III radar, and on the night of July 2nd-3rd a Blenheim IF from the Fighter Interception Unit at Ford gained the first "kill" by means of this equipment. Subsequently the Blenheim IF was to provide the backbone of R.A.F. Fighter Command's night interception force, soldiering on into the *Luftwaffe's* nocturnal *Blitz* of 1940-41 until finally supplanted by the Beaufighter.

Part Two

THE ATTACKERS

The Messerschmitt Bf 109

DURING the weeks immediately following the successful termination of the campaign on the continent, the *Luftwaffe's* single-seat fighter forces, the *Jagdflieger*, were largely preoccupied with making good the attrition that they had suffered. When the assault in the West had begun on May 10, 1940 the two Air Fleets involved, *Luftflotten* 2 and 3, had included 1,016 Messerschmitt Bf 109 single-seat fighters in the forces at their disposal, and by July 20th, 10 weeks after the opening of the western offensive, the fighter strength of the *Luftflotten* had been restored to 80 per cent of that with which they had begun the campaign, their *Jagdgruppen* possessing 809 Bf 109Es of which 656 were serviceable.

Three weeks later, on August 10th, three days before the launching of *Adlerangriff*, the number of Bf 109Es available to the *Luftflotten* had risen to 934 of which 805 were serviceable, more than enough, in the view of the loquacious *Reichsmarschall* Göring, to overcome whatever opposition was likely to be provided by R.A.F. Fighter Command.

The *Reichsmarschall's* confidence was shared by the pilots themselves who believed, not without some justification, that the Messerschmitt Bf 109E on which they were mounted was superior to any fighter extant. The Bf 109 *was* an inspired design, and in overall concept it was remarkably similar to the Spitfire, although its angular lines which endowed it with an air of ruthless efficiency contrasted sharply with the aesthetically appealing contours of its British contemporary. Unlike the Spitfire, the Bf 109 had no illustrious sires but, despite undistinguished pedigree, it was a true thoroughbred.

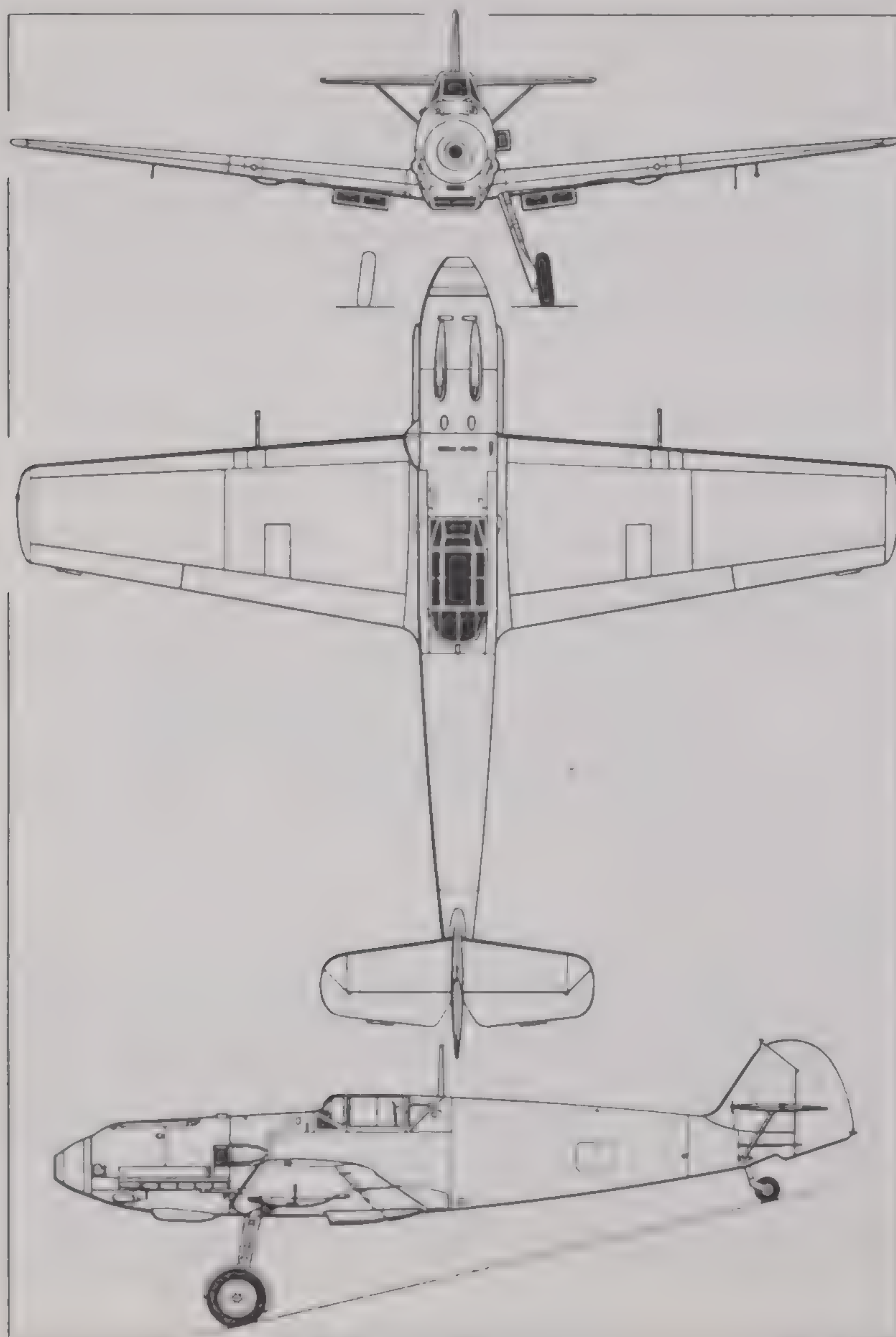
Its creators, Dipl.-Ing. Willy Messerschmitt and his Chief Engineer, Ing. Walter Rethel, made no concessions to the traditionalists, taking full advantage of the most advanced aerodynamic and structural techniques to achieve what they considered to be the ultimate in performance. Like the Spitfire it was of all-metal stressed-skin construction, but its German designers elected to use a much higher wing loading, compensating for this to some extent by adopting automatic Handley Page leading-edge slots and slotted trailing-edge flaps.

The first prototype of the Messerschmitt fighter, the Bf 109 VI, was flown for the first time early in September 1935 at Augsburg-Haunstetten by "Bubi" Knötsch. Powered by a Rolls-Royce Kestrel V engine affording 695 h.p. for take-off, it displayed a maximum speed of 290 m.p.h. in level flight but was viewed with some suspicion by officials of the *Reichsluftfahrtministerium*, Germany's Air Ministry, whose test pilots looked askance at its steep ground angle and resultant poor view for taxiing, its sideways-hinging cockpit canopy, high wing loading and automatic wing slots. Messerschmitt patiently explained that the ground angle had been selected in order to obtain the steepest practicable incidence and, therefore, the highest lift coefficient when landing, and that the slots were fitted to provide improved aileron control near the stall.

Further prototypes were completed with the Junkers Jumo 210 engine of roughly comparable performance to the Kestrel mounted by the first prototype, and after competitive

The Messerschmitt Bf 109

evaluation with other fighters designed to meet the same requirement, the aircraft entered production as the Bf 109B in



the late autumn of 1936. The initial model with a two-bladed wooden Schwarz fixed-pitch airscrew driven by a Junkers Jumo 210Da engine offering 680 h.p. for take-off began to reach the *Luftwaffe* in the early spring of 1937. The premier *Luftwaffe* fighter group, *Jagdgeschwader* 132 "Richtshofen", had been designated the first unit to receive the Messerschmitt fighter, but the re-equipment of part of the fighter component of the Condor Legion flying in Spain took precedence, and shortly after the arrival of the first Bf 109Bs in April 1937 the new fighter was firing its guns in anger with the 2. *Staffel* of *Jagdgruppe* 88.

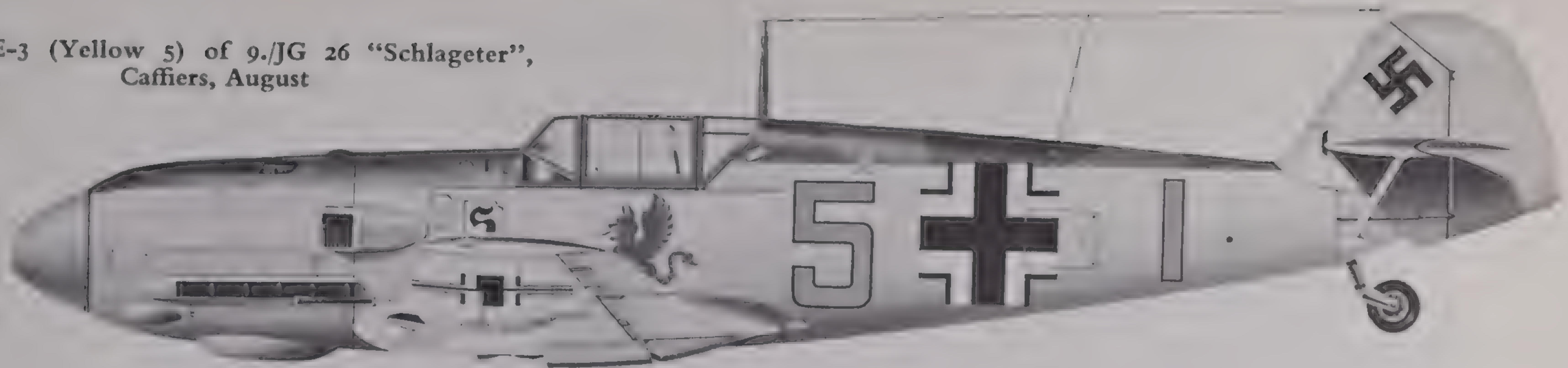
Development of the fighter was rapid. The fixed-pitch airscrew quickly gave place to a VDM-Hamilton variable-pitch metal airscrew, armament was progressively increased, and the Jumo 210 series of engines was succeeded by power plants of greater output and of Daimler-Benz design. The Bf 109D received the 986 h.p. Daimler-Benz DB 600Aa but priority in the allocation of the DB 600 was allocated to the He 111 bomber, and by 1938, when emphasis began to shift from bombers to fighters, this engine was already being phased out in favour of the superior DB 601 which was envisaged as the definitive power plant for the Bf 109 fighter.

The DB 601 employed a direct fuel injection system in place of the carburettor of the DB 600, this enabling it to function under negative g without cutting or spluttering, and affording *Luftwaffe* fighters a distinct advantage over their opponents during the Battle of Britain. Various problems conspired to delay quantity deliveries of the DB 601 engine, and thus the first version of the Messerschmitt fighter to receive this power plant, the Bf 109E-1, did not begin to reach the *Jagdflieger* until the beginning of 1939.

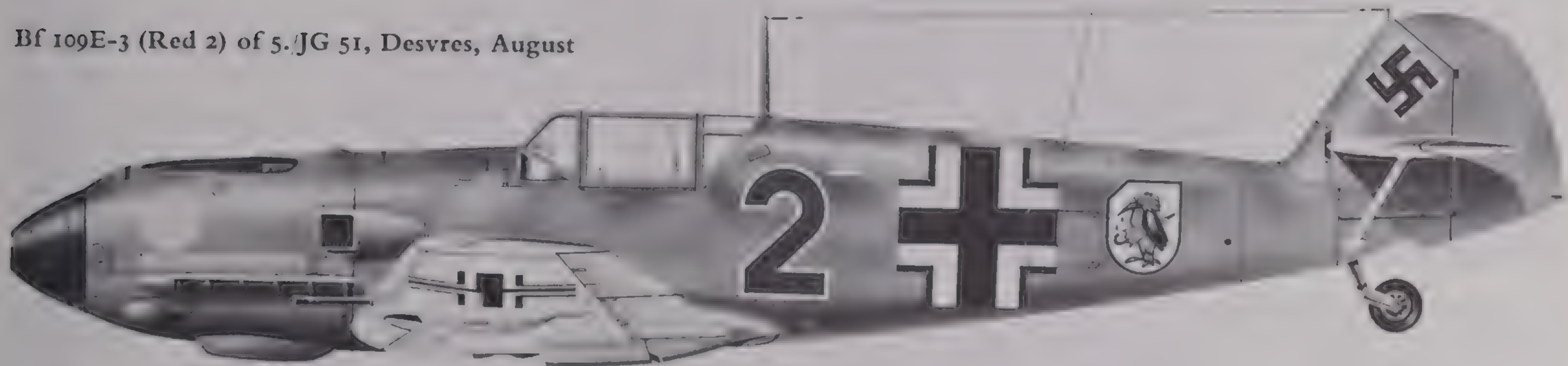
Powered by a DB 601A engine rated at 1,100 h.p. at 12,140 ft. and driving a three-bladed variable-pitch airscrew, the Bf 109E-1 had two 7.9-mm. MG 17 machine guns in the upper decking of the nose with 1,000 rounds of ammunition

The Messerschmitt Bf 109

Bf 109E-3 (Yellow 5) of 9./JG 26 "Schlageter",
Caffiers, August



Bf 109E-3 (Red 2) of 5./JG 51, Desvres, August



Bf 109E-3 (Yellow 4) of 9./JG 2 "Richthofen", Le
Havre, August



The Messerschmitt Bf 109



per gun, and these were coupled with two similar weapons in the wings or two wing-mounted 20-mm. drum-fed MG FF (Oerlikon) cannon each with 60 shells, the latter eventually being standardised. At this stage, the Bf 109E, like the Spitfire, was provided with no bullet-proof windscreen or armour, features to be introduced in the light of operational experience. It offered excellent handling characteristics and response at low and medium speeds, a good low-speed climb angle, a gentle stall without any tendency to spin, and a short take-off run. Its climbing and diving performances were second to none, but manoeuvrability suffered by comparison with the Hurricane and Spitfire, controls became progressively heavier as speed was increased, and the absence of a rudder trimmer necessitated the continuous application of rudder in order to fly straight at high speeds.

Late in 1939, the Bf 109E-3 had begun to supplant the E-1 on the assembly lines, this standardising on the wing-mounted

(Below) Bf 109E-3 fighters of 8./JG 2 "Richthofen" immediately prior to the "Battle", and (left) Bf 109E-3s on the Channel Coast, Summer 1940





(Above and right) Bf 109E-1/B and E-4/B fighter-bombers of the Erprobungsgruppe 210

MG FF cannon and adopting a DB 601Aa engine which had provision for the mounting of a 20-mm. MG FF/M cannon on the crankcase. In the event, difficulties with the engine-mounted weapon were such that it was rarely used and was often removed by forward maintenance units. A cockpit canopy of revised design and embodying heavier framing and bullet-proof windscreen was accompanied by seat armour, and with the introduction of the Bf 109E-4 the engine-mounted cannon was finally discarded and wing-mounted weapons of improved fire rate provided. Some Bf 109E-1s were retroactively modified for the fighter-bomber or *Jabo* role under the designation Bf 109E-1/B, and some Bf 109E-4s



The Messerschmitt Bf 109

on the assembly lines were similarly equipped, these carrying a single 551-lb. bomb or four 110-lb. bombs.



(Above) Bf 109E-3s of III/JG 27, and (below) a Bf 109E-4/B of II/JG 54 in post-Battle of Britain finish and markings

On *Adlertag* the Bf 109E-equipped element of *Luftflotte 2* was provided by the three *Gruppen* (each approximating roughly to an R.A.F. Wing and comprising three or more *Staffeln*) of each of *Jagdgeschwader* 3, 26, 51 and 52, plus the Bf 109E-1/B and E-4/B fighter-bombers of *Erprobungsgruppe* 210, the primary task of which was the development of effective fighter-bomber tactics, and one *Gruppe* of *Jagdgeschwader* 54. The Bf 109E units attached to *Luftflotte 3* were the three *Gruppen* of each of *Jagdgeschwader* 2, 27 and 53.

These units now embarked on what was to be a three-month strategic battle with the knowledge that the Bf 109E had sufficient endurance for a mere 20 minutes actual combat over Britain, and that London represented the effective limit of its tactical radius. While *Reichsmarschall* Göring undoubtedly underrated the effectiveness of the British fighters, his most serious error of judgement was his appreciation of the British aircraft industry's ability to make good R.A.F. Fighter Command's attrition.

At the outset the Bf 109E was assigned the primary task of



The Messerschmitt Bf 109

engaging the opposing British fighters in open combat, and the *Jagdflieger* were able to take full advantage of the superior climbing and diving capabilities that their fighters enjoyed over their opponents. When the vulnerability of the twin-engined Bf 110 became obvious, the Bf 109E units had also to provide close escort for the bomber formations, and the fewer than 700 serviceable single-seat fighters available to *Luftflotten* 2 and 3 were inadequate for the dual role. The Bf 109E could no longer use its speed to advantage, and the fact that it could be out-turned by both the Spitfire and the Hurricane now gave the British fighters the upper hand.

The operational attrition of the *Jagdgruppen* steadily escalated, and the situation in which the Bf 109E units found themselves was further aggravated when, as a result of the heavy casualties suffered by the bomber formations, Göring insisted that the single-seat fighters stay still closer to their charges. The *Jagdflieger*, which had previously considered themselves the hunters, now began to see themselves as the hunted owing to the strict limitations placed on their tactics, and at the end of October the emasculated Bf 109E units were withdrawn from the assault, their personnel suffering, like their British counterparts, from physical and nervous strain.

Wartime propaganda notwithstanding, the Messerschmitt Bf 109E had given a good account of itself in a battle such as was not envisaged at the time it joined the ranks of the *Luftwaffe*. During the Battle of Britain its limited tactical radius had placed it at a constant disadvantage, but its performance and armament were formidable, and when its pilot was permitted to pursue the tactics best suited to his mount the Bf 109E was perhaps the best fighter extant. In the final tally the Battle of Britain had cost the *Jagdgruppen* 610 Bf 109Es in action of which perhaps 10 per cent came down in the channel after exhausting their fuel, but this warplane had accounted for the bulk of the 1,172 aircraft lost by R.A.F. Fighter Command over the same period.



An early production Bf 109E-3

Messerschmitt Bf 109E-3 Specification

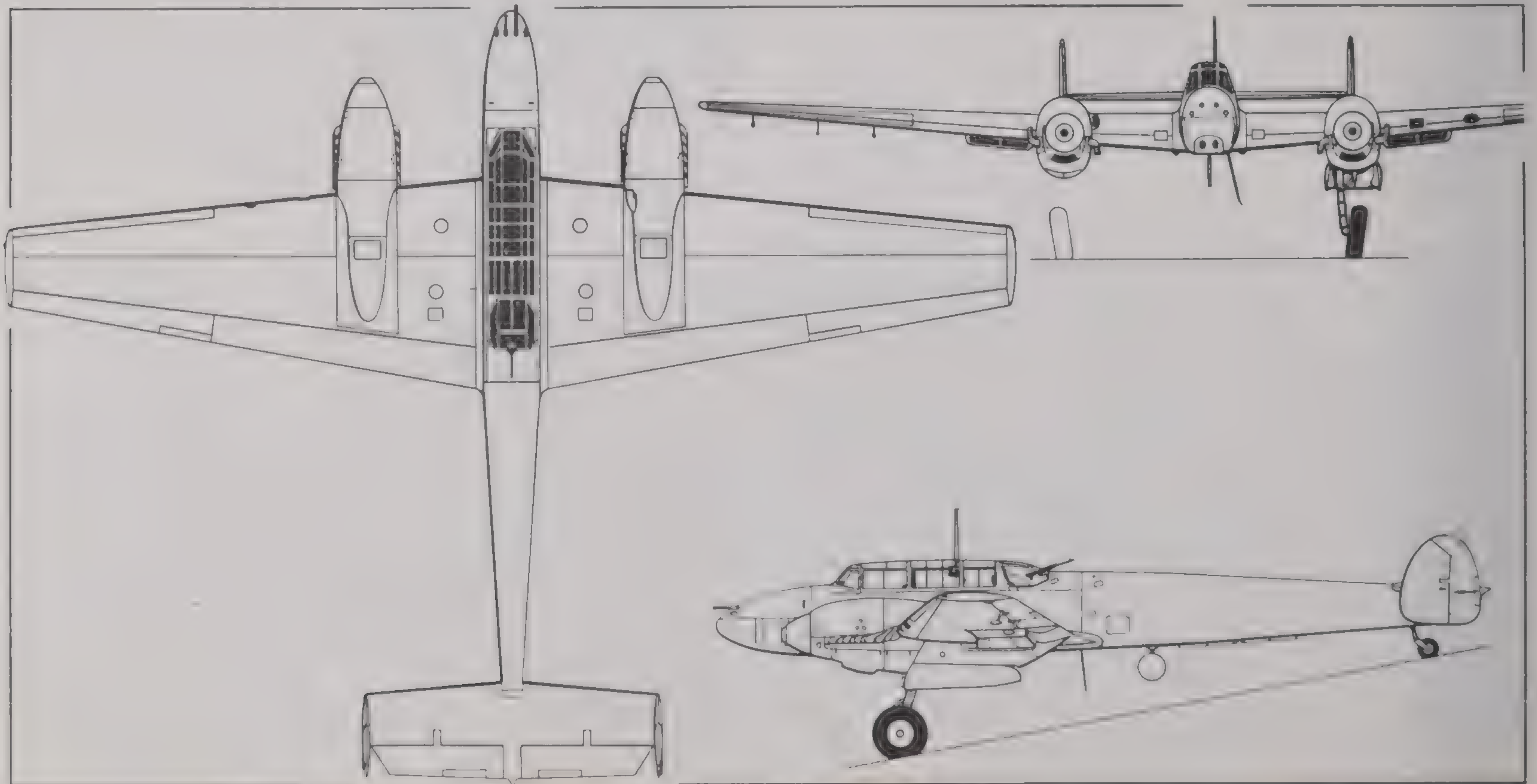
Type:	Single-seat Fighter.
Power Plant:	One Daimler-Benz DB 601Aa 12-cylinder liquid-cooled engine rated at 1,100 h.p. for take-off and 1,020 h.p. at 14,765 ft.
Performance:	Maximum speed (at 5,875 lb.), 293 m.p.h. at sea level, 307 m.p.h. at 3,280 ft., 322 m.p.h. at 6,560 ft., 348 m.p.h. at 14,560 ft., 336 m.p.h. at 19,685 ft.; maximum continuous cruising speed, 300 m.p.h. at 13,120 ft.; range cruising speed, 202 m.p.h. at 3,280 ft., 210 m.p.h. at 6,560 ft., 233 m.p.h. at 22,965 ft.; maximum range, 410 mls.; initial climb rate, 3,280 ft./min.; time to 9,840 ft., 3.1 min., to 19,685 ft., 7.1 min.; service ceiling, 34,450 ft.
Weights:	Empty, 4,189 lb.; empty equipped, 4,685 lb.; loaded, 5,875 lb.
Armament:	Two 20-mm. MG FF cannon with 60 r.p.g. in wings and two 7.9-mm. MG 17 machine guns with 1,000 r.p.g., or two 7.9-mm. MG 17 machine guns with 500 r.p.g. and one engine-mounted 20-mm. MG FF/M cannon with 180 rounds.
Dimensions:	Span, 32 ft. 4½ in.; length, 28 ft. 4½ in.; height, 8 ft. 2½ in.; wing area, 176.53 sq. ft.

The Messerschmitt Bf 110

THE first days of August 1940 saw the Messerschmitt Bf 110 strategic fighters of what, to *Reichsmarschall* Hermann Göring, represented the élite formations of the *Luftwaffe*, the *Zerstörergruppen*, poised on bases in France and the Low Countries for the commencement of *Adlerangriff*, the “Attack of the Eagles” as the all out aerial offensive against Britain had been dubbed. The *Zerstörer*, or “Destroyer”, units were invincible, according to German propagandists, but in the weeks that followed the long-range Bf 110 heavy fighters

were to receive a near-disastrous mauling from the more nimble Hurricanes and Spitfires, and rather than serve in the escort role as foreseen, the farcical situation was to arise in which the escort fighters had themselves to be escorted by Bf 109Es!

The lack of success that was to accompany the Bf 110 in the Battle of Britain was widely construed as the failure of this shapely warplane itself, and the belief that the Bf 110 was an unsuccessful design was to persist. To the contrary, however,





the Bf 110 was a highly effective warplane once the limitations of its category were appreciated. The poor results attending its operations in that fateful summer of 1940 were primarily due to the deployment of the Bf 110 in a fashion presupposing a measure of aerial superiority, and this the *Luftwaffe* was rarely to enjoy over Britain.

The strategic fighter had to be a compromise between conflicting requirements, and compromises are rarely good enough in the hard school of war. The Germans borrowed from naval parlance in referring to their heavy long-range fighter as a *Zerstörer* which was envisaged as a warplane embodying high performance and heavy armament coupled with sufficient endurance to permit the escort of bombers,

(Above) A Bf 110C-4/B of similar type to that employed in the "Battle" by E.Gr.210, and (right) a Bf 110C-3



The Messerschmitt Bf 110



deep-penetration offensive sorties over enemy territory, and the maintenance of standing patrols at a considerable distance from base.

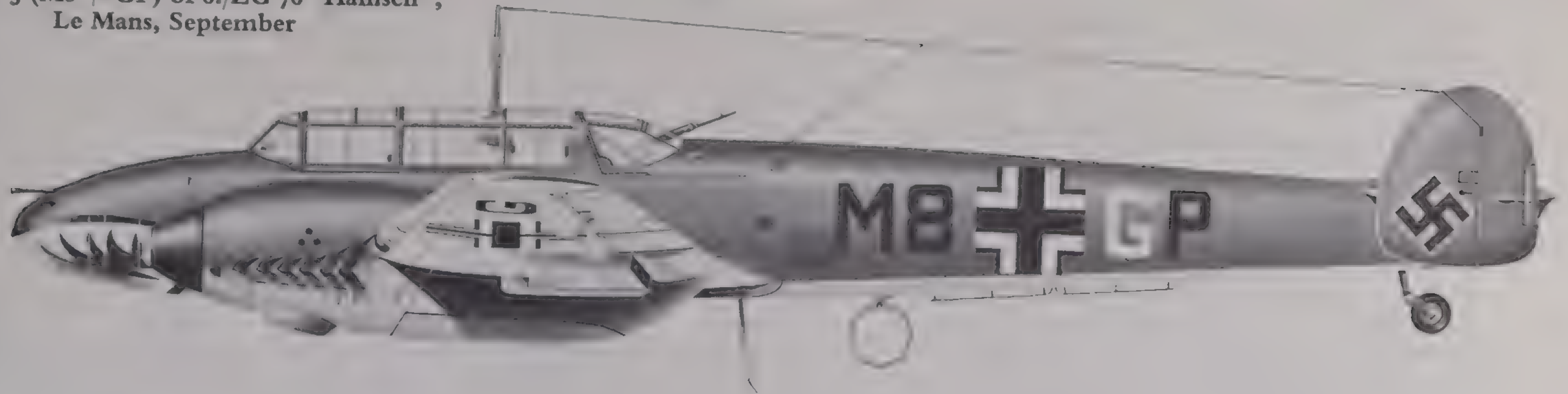
The Bf 110 followed the structural formula established for the single-engined Bf 109, being an all-metal stressed-skin aircraft, the single-spar wings of which carried Handley Page automatic slots on the leading edges and hydraulically-operated slotted flaps on the trailing edges. The first prototype, the Bf 110 V1, was powered by two Daimler-Benz DB 600A engines each affording 910 h.p. at rated altitude and driving a three-bladed variable-pitch airscrew, and flight testing began from Augsburg-Haunstetten on May 12, 1936 with Rudolf Opitz at the controls.

(Left) A Bf 110C-4 of ZG 1, and (below) a Bf 110C-3 of 6./ZG 76. ZG 1 and ZG 76 were known as the "Wespengruppe" and "Haifischgruppe" respectively

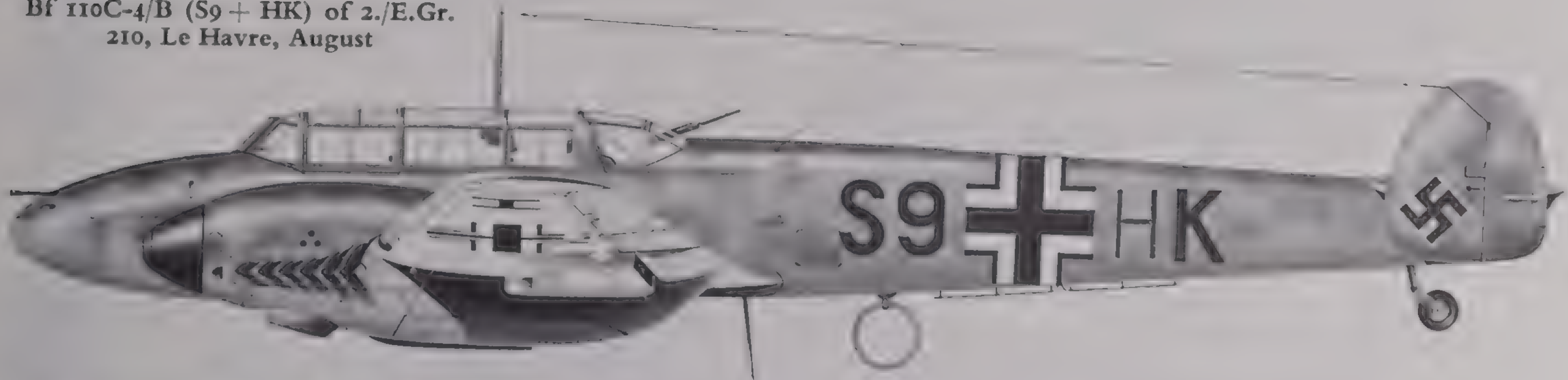


The Messerschmitt Bf 110

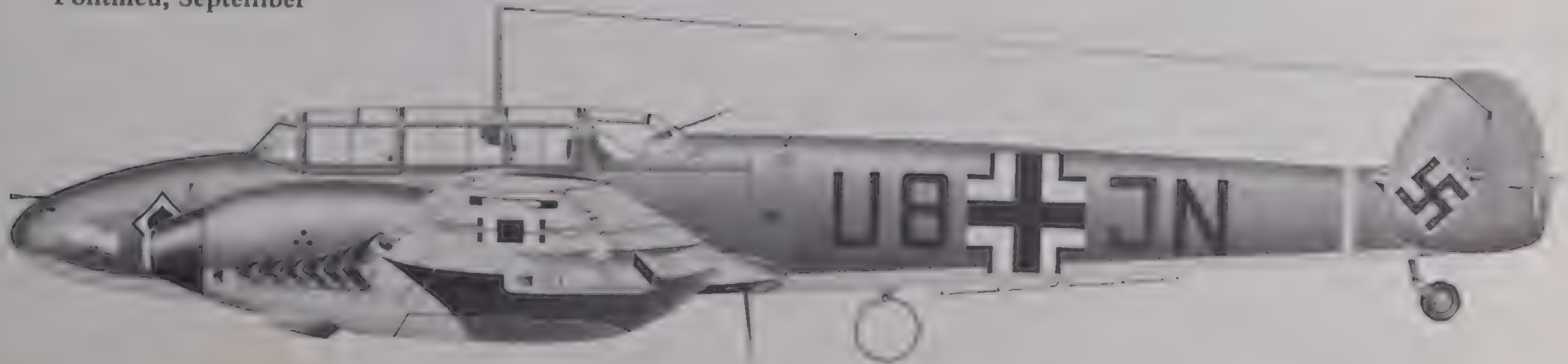
Bf 110C-3 (M8 + GP) of 6./ZG 76 "Haifisch",
Le Mans, September



Bf 110C-4/B (S9 + HK) of 2./E.Gr.
210, Le Havre, August



Bf 110C-1 (U8 + JN) of 5./ZG 26, Crecy-en-
Ponthieu, September



The Messerschmitt Bf 110

Although possessing somewhat poor acceleration and a marginal stability problem in the lower and intermediate speed ranges, the prototype displayed generally good handling characteristics and an acceptable standard of manoeuvrability, and soon clocked a speed of 314 m.p.h. in level flight. The initial production model was scheduled to receive the DB 600Aa engines but these power plants were considered

basically unsuited for fighter installation, and with the decision to standardise on the superior DB 601 the Bf 110A version was restricted to a few pre-production examples.

Delays in the availability of the DB 601A necessitated the installation of the lower-powered Junkers Jumo 210Ga engine in the next version, the Bf 110B, and as the performance of this model was considered inadequate for combat tasks, the two score or so Bf 110Bs completed during 1938 were restricted to training and other non-operational roles. Such was the importance attached to the *Zerstörer* programme that the highest priority was allocated to production of the Messerschmitt twin-engined fighter, and as the Bf 110C with DB 601A-1 engines it began to leave the assembly lines in January 1939. Eight months later, when hostilities began, the Bf 110C was leaving the factories at a rate of more than 30 per month. A total of 159 had been accepted by September 1, 1939, three *Zerstörergruppen* having attained operational

(Left) A Bf 110D with "Dackelbauch" as used by I/ZG 76, and (below) Bf 110C-5 of 4.(F)/14 forced down at Goodwood on July 21, 1940





This Bf 110C-1 was built by Focke-Wulf, one of several companies that manufactured this *Zerstörer* under licence

status on the Bf 110C with other *Gruppen* in process of working up on the type, and with the further 156 delivered during the first four months of World War Two, a total of 315 Bf 110C fighters had been accepted by the *Luftwaffe* by January 1, 1940, and production was rising rapidly.

On May 10, 1940 the *Luftwaffe*'s operational inventory included 355 Bf 110C-1 and C-2 fighters, the latter differing only in radio equipment and in having an improved rear gunner's position. Of these 248 were attached to *Luftflotten* 2 and 3 for the assault in the West, and during the subsequent fighting on the continent the Bf 110 was considered to have gained its spurs. On occasions when the Bf 110 *did* encounter relatively modern single-seat interceptors, however, it was found that the twin-engined fighter could not compete on even terms. Thus, when enemy single-seaters were encountered in strength—a rare event in French skies but one

that was to become commonplace over the British Isles—the Bf 110s formed a defensive circle, protecting each other's tail and enabling several guns to be brought to bear simultaneously against fighters attacking the periphery.

By the time the first skirmishes of the Battle of Britain took place over the channel several modified versions of the Bf 110 had joined the ranks of the *Luftwaffe*. The *Zerstörergruppen* had received the Bf 110C-3 and C-4 mounting improved 20-mm. MG FF cannon, the latter providing for the first time some armour protection for the pilot and radio-operator/gunner, the Bf 109E fighter-bombers of *Erprobungsgruppe* 210 had been joined by the Bf 110C-4/B fighter-bomber, and several long-range reconnaissance *Staffeln* had taken the Bf 110C-5 on strength, this model having a camera and lacking the pair of 20-mm. MG FF cannon in the forward fuselage. To these was added the Bf 110D-1 with a plump appendage to the

The Messerschmitt Bf 110

fuselage dubbed a *Dackelbauch*, or "Dachsund-belly", and contained 264 Imp. gal. of fuel. Delivered to the I Gruppe of *Zerstörergeschwader* 76, the *Dackelbauch*-equipped Bf 110 was extremely unwieldy, and even with fuel exhausted the drag of the immense ventral "blister" had a most adverse effect on performance. In theory the *Dackelbauch* was to be jettisoned as soon as its contents were exhausted, but it had a tendency to "hang up", and on the one occasion that I/ZG 76 flew in strength to participate in the Battle of Britain (August 15, 1940) it suffered heavy casualties which were undoubtedly contributed to by the failure of most Bf 110D-1s to dislodge their empty *Dackelbauches*.

On July 20, 1940, a total of 280 Bf 110 fighters was available to *Luftflotten* 2, 3 and 5 of which 200 were serviceable, and this total remained virtually unchanged when the *Zerstörergruppen* embarked upon *Adlerangriff*. To the chagrin of the *Luftwaffe* the Bf 110 immediately proved itself incapable of defending the bombers whose task it was to escort. Indeed, it was hard put to defend itself. Its acceleration and speed were insufficient to enable it to avoid combat with opposing fighters, and by comparison with the Hurricane and Spitfire its manoeuvrability was sluggish. The R.A.F. fighters found it easy to evade the potent forward-firing armament, and the single machine gun provided for rear defence proved totally inadequate. The losses suffered by the *Zerstörergruppen* were out of all proportion to their achievements, no fewer than 120 Bf 110s being lost on operations during August alone, and Messerschmitt's heavy fighter should have been withdrawn from the battle. However, the overall shortage of fighters coupled with the inadequate range of the single-seat Bf 109 necessitated the Bf 110's retention, and despite changed tactics a further 83 were lost on operations in September.

The participation of the Bf 110 in the Battle of Britain was undeniably catastrophic. It was a dismal failure in the type of

conflict to which it was committed, a failure particularly embarrassing to *Reichsmarschall* Göring whose boastful claims for the *Zerstörergruppen* had proved to have little basis in fact. But the Bf 110 was *not* an aircraft of indifferent quality as its showing in the Battle of Britain suggested. It was a thoroughly competent design but the limitations of its concept were only fully appreciated as a result of the losses that it suffered in British skies, and it was subsequently to serve the *Luftwaffe* well in a variety of roles.

Messerschmitt Bf 110C-1 Specification

Type:	Two- or Three-seat Long-range Fighter.
Power Plants:	Two Daimler-Benz DB 601A-1 12-cylinder liquid-cooled engines each rated at 1,050 h.p. for take-off and 1,100 h.p. at 12,140 ft.
Performance:	Maximum speed (at 13,289 lb.), 295 m.p.h. at sea level, 326 m.p.h. at 13,120 ft., 336 m.p.h. at 19,685 ft.; maximum continuous cruising speed, 262 m.p.h. at sea level, 304 m.p.h. at 16,400 ft., 301 m.p.h. at 22,970 ft.; economical cruising speed, 217 m.p.h. at 13,780 ft.; range with normal internal fuel at maximum continuous cruise, 481 mls. at sea level, 528 mls. at 16,400 ft., 565 mls. at 22,970 ft., at economical cruise, 680 mls. at 13,780 ft.; initial climb rate, 2,165 ft./min.; time to 19,685 ft., 10.2 min.; service ceiling, 32,810 ft.
Weights:	Empty, 9,755 lb.; empty equipped, 10,769 lb.; loaded, 13,289 lb.; maximum overload, 14,880 lb.
Armament:	Two 20-mm. MG FF cannon with 180 r.p.g. and four 7.9-mm. MG 17 machine guns with 1,000 r.p.g. firing forward, and one aft-firing 7.9-mm. MG 15 machine gun on flexible mounting with 750 rounds.
Dimensions:	Span, 53 ft. 3½ in.; length, 39 ft. 7¼ in.; height, 13 ft. 6½ in.; wing area, 413.334 sq. ft.

The Junkers Ju 87

NO warplane of World War Two was more widely discussed nor aroused greater controversy than the Junkers Ju 87, an angularly ugly dive bomber which, until the Battle of Britain, was to enjoy greater notoriety than any aircraft in the *Luftwaffe's* inventory. This Junkers product, which became synonymous with the abbreviation "Stuka"—from *Sturzkampfflugzeug*, a term descriptive of all dive bombers—was believed by its advocates to be the supreme weapon, and their claims propagated so assiduously appeared borne out by the almost legendary reputation with which it emerged from the Polish and French campaigns.

The Ju 87 *was* an evil-looking machine with something of the

predatory bird in its ugly contours, but it was an extremely sturdy warplane with light controls, pleasant flying characteristics, and a relatively high standard of manoeuvrability. It offered its crew members good visibility and it was able to hit its target in a diving attack with an accuracy of less than 30 yards. All these were highly desirable characteristics but they tended to blind the *Luftwaffe* to the Ju 87's shortcomings. Its use presupposed control of the air for it was one of the most vulnerable of combat aircraft and the natural prey of the fighter, and as soon as it encountered determined fighter opposition in the skies above the British Isles the Ju 87's dramatic career entered its eclipse.

Ju 87B-2s of IV (Stuka)/LG I providing part of the dive bombing component of the II Fliegerkorps



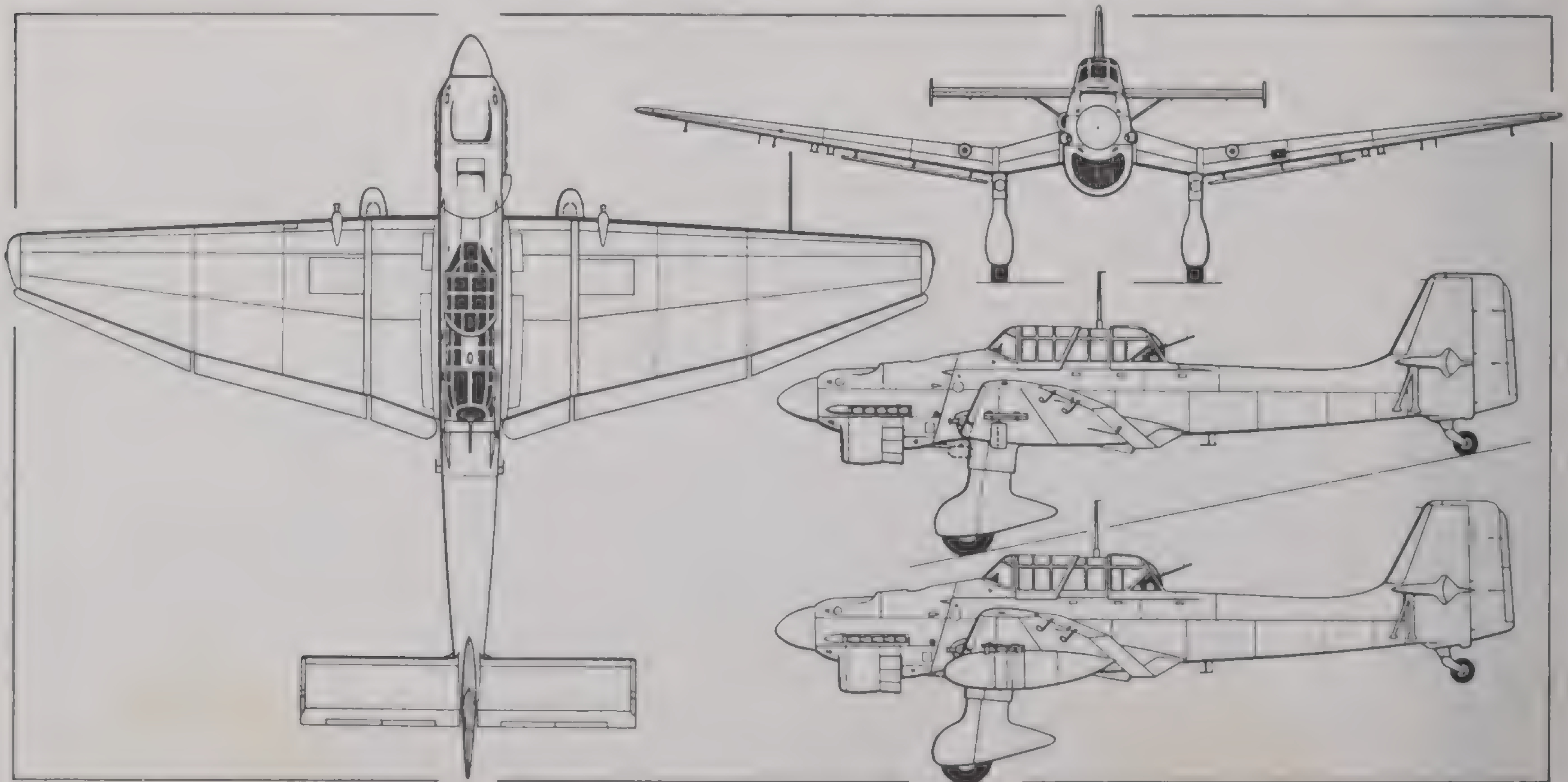
The Junkers Ju 87

Design of the Ju 87 had been initiated in 1933 by Dipl.-Ing. Hermann Pohlmann, and like many other German prototypes of the period, the first example, the Ju 87 V1 which flew in the spring of 1935, was powered by a Rolls-Royce Kestrel V engine rated at 640 h.p. at 14,000 ft. Subsequent prototypes received the Junkers Jumo 210Aa affording 610 h.p. at 8,550 ft., and this gave place in the initial production model, the Ju 87A, to the Jumo 210Ca providing 640 h.p. at rated altitude.

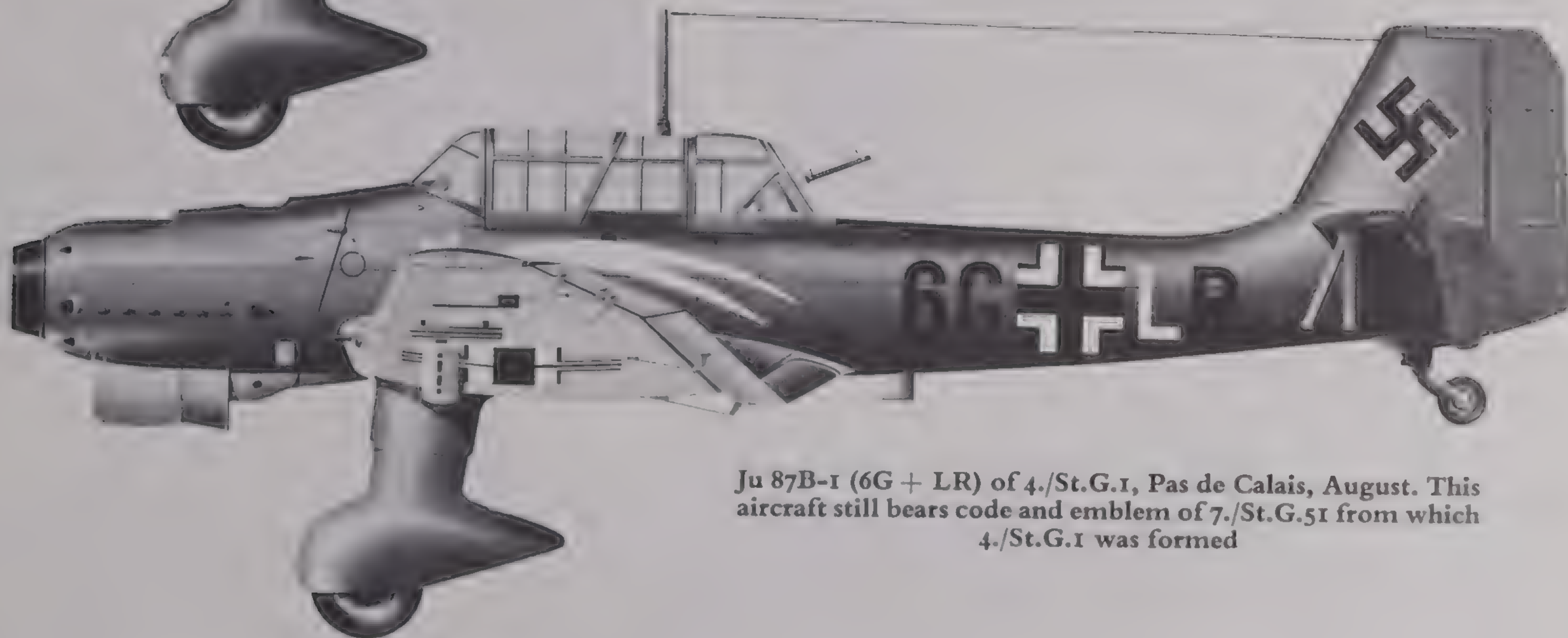
The Ju 87A entered *Luftwaffe* service early in 1937, and with the availability of the appreciably more powerful Jumo 211 engine during the course of the year the opportunity was

taken to initiate a major redesign of the aircraft. In consequence, by the late spring of 1938 production of the Ju 87A was phasing out at Junkers' Dessau factory, and preparations were being made to manufacture the redesigned, more powerful model as the Ju 87B at the Berlin-Tempelhof factory of the "Weser" Flugzeugbau.

By comparison with the initial model only the wings and horizontal tail surfaces of the Ju 87B remained unchanged, and its Jumo 211Da direct fuel-injection engine provided an emergency and take-off output of 1,200 h.p. This substantial increase in power enabled the dive bomber to lift a 1,102-lb. bomb with the full complement of two crew members—



Ju 87B-2 (T6 + AN) of 5./St.G.2 "Immelmann"
St. Omer, September



Ju 87B-1 (6G + LR) of 4./St.G.1, Pas de Calais, August. This
aircraft still bears code and emblem of 7./St.G.51 from which
4./St.G.1 was formed

the Ju 87A had been capable of lifting such loads only when flown as a single-seater. The Ju 87B-2 differed from the B-1 which it supplanted on the "Weser" assembly line late in 1939 in incorporating a number of refinements, such as ejector exhausts, hydraulically-operated radiator cooling gills,

and an improved broad-bladed airscrew, and both sub-types equipped the *Stukagruppen* when, on July 6, 1940, they began regrouping in preparation for the launching of *Adlerangriff*. In addition, the I Gruppe of *Stukageschwader* 1 was operating the Ju 87R-1 intended primarily for anti-shipping and other



(Above) Ju 87B-2 of 6./St.G.2, and (below left) a Ju 87B-1 of 4./St.G.77



extended-range missions, the "R" suffix letter indicating *Reichweite* (Range).

The first tentative dive bombing attacks of the Battle of Britain were performed against British coastal shipping in July, these being a prelude to the main assault for which, by the 20th of the month, *Luftflotten* 2 and 3 had gathered 316 Ju 87Bs and Ju 87Rs, 248 of which were serviceable. Most of the dive bombers were embodied by von Richthofen's VIII *Fliegerkorps* which included the *Stukagruppen* of *Stukageschwader* 1, 2 and 77, *Stukageschwader* 3 forming part of IV *Fliegerkorps*, and the II *Gruppe* of *Stukageschwader* 1 plus IV

(*Stuka*)/LG 1 providing the dive bombing component of II *Fliegerkorps*.

The first dive bomber sorties in strength took place on August 8th, three days before *Adlertag*, and despite a top cover of Bf 109E fighters the *Stukagruppen* suffered severe losses. But this was only a foretaste of what was in store for the Ju 87 units. On *Adlertag* itself a formation of Ju 87s *en route* for Middle Wallop airfield was bounced by Spitfires of No. 609 Squadron which promptly despatched nine of the dive bombers, the others scattering. From this point on dive bomber losses escalated rapidly to a point where the attrition was no longer acceptable. The Ju 87 had been revealed for what it was, a poorly-armed, somewhat cumber-

(Right) A Ju 87B-1 of the Geschwaderstab St.G.77, and (below)
a Ju 87B-1 of 9./St.G.1



The Junkers Ju 87

some and highly vulnerable aircraft, and to prevent the *Stukagruppen* from being decimated they were withdrawn from the Cherbourg area to the Pas de Calais where they were to sit out the final phases of the Battle of Britain, the last dive bomber sortie in force against British targets taking place on August 30th.



(Above) This view shows clearly the inverted gull wing of the Ju 87B-2. (Below) Ju 87B-2s of 7./St.G. 77 being prepared for a mission

Junkers Ju 87B-1 Specification

Type:	Two-seat Dive Bomber.
Power Plant:	One Junkers Jumo 211Da 12-cylinder liquid-cooled engine rated at 1,200 h.p. for take-off and 1,100 h.p. at 4,920 ft.
Performance:	Maximum speed, 211 m.p.h. at sea level, 238 m.p.h. at 13,410 ft.; maximum cruising speed, 209 m.p.h. at 12,140 ft.; economical cruising speed, 175 m.p.h. at 15,090 ft.; maximum range with 1,102-lb. bomb, 370 mls., without external load, 490 mls.; time to 3,280 ft., 2 min., to 6,560 ft., 4.3 min., to 12,190 ft., 12 min.; service ceiling, 26,250 ft.
Weights:	Empty, 5,980 lb.; empty equipped, 6,090 lb.; maximum loaded, 9,560 lb.
Armament:	Two fixed forward-firing 7.9-mm. MG 17 machine guns and one 7.9-mm. MG 15 machine gun on flexible mounting in rear cockpit. (Offensive) One 1,102-lb. bomb or one 551-lb. and four 110-lb. bombs.
Dimensions:	Span, 45 ft. 3½ in.; length, 36 ft. 5 in.; height, 13 ft. 2 in.; wing area, 343.368 sq. ft.



The Junkers Ju 88

THE Junkers Ju 88 exemplified, it has been suggested, the German philosophy of using one good basic airframe for a multitude of tasks rather than evolving a variety of specialized machines and thus complicating production. This suggestion is, however, a misleading simplification of the facts, for the supreme amenability to the process of adaptation and modification to which this warplane was to be subjected was purely fortuitous and the result of no remarkable foresight on the part of the Technical Department of the *Reichsluftfahrtministerium* in framing the original specification which gave the Ju 88 birth. But when the Ju 88 participated in the Battle of Britain it was still on the threshold of its service career, and its remarkable versatility had still to manifest itself.

The Ju 88 was designed to fulfil a demand for a *Schnellbomber*—a high-speed bomber in which performance would be uncompromised by any need on the part of the designer to keep in mind potential suitability for other roles. The first prototype, the Ju 88 V1, had made its initial flight on December 21, 1936 with Junkers' chief test pilot, *Flugkapitän* Kindermann, at the controls. Of all-metal stressed-skin construction, the Ju 88 revealed an outstanding performance from the earliest flight testing—the third prototype, the Ju 88 V3, attaining 323 m.p.h. in level flight—and large-scale production was initiated during the summer preceding World War Two.

The first production model, the Ju 88A-1, deliveries of which to the *Luftwaffe* began almost simultaneously with the commencement of hostilities, carried four crew members grouped closely in the fuselage nose forward of the front wing spar. Two internal bomb-bays were provided, these being capable of housing a maximum of 28 110-lb. SC 50 bombs, and two external carriers were fitted beneath each wing in-board of the engines, these each being capable of lifting a

1,102-lb. bomb but normally carrying 220-lb. bombs when maximum internal bomb load was being carried. During development of the Ju 88 the Technical Department had modified its specification to include dive bombing capability, and, accordingly, slatted dive brakes were hinged beneath the front spar.

Like most new combat aircraft, the Ju 88A-1 suffered its share of teething troubles. For example, the dive brakes gave considerable trouble when extended, the fuselage already being highly stressed, and limitations had to be imposed on

Ju 88A-1s being prepared for Luftwaffe delivery





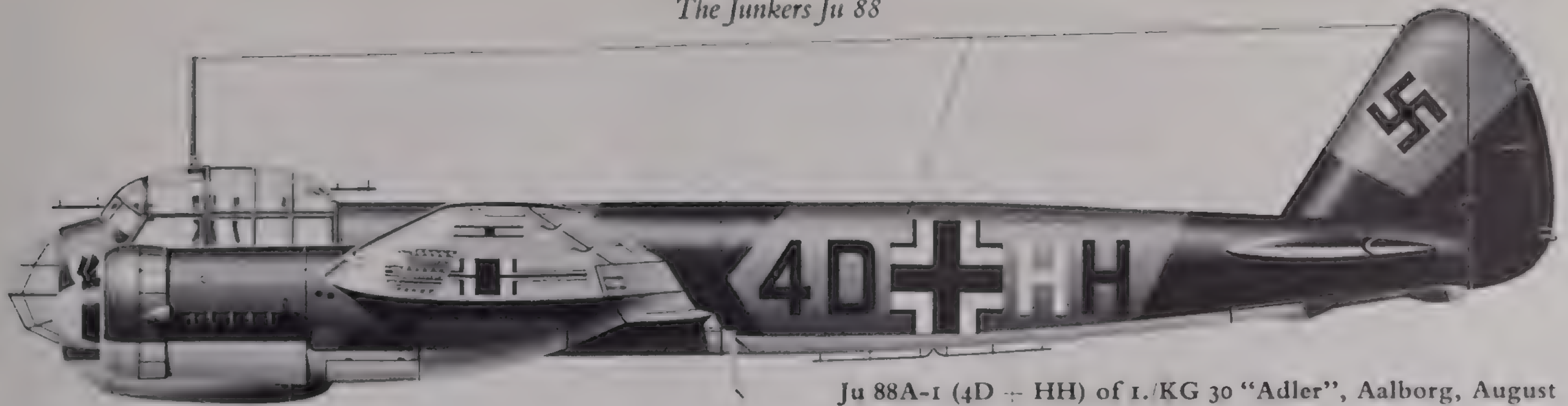
(Above) a Ju 88A-1 of KG 30, and (below) a view of the Ju 88A-1 clearly showing the external bomb racks



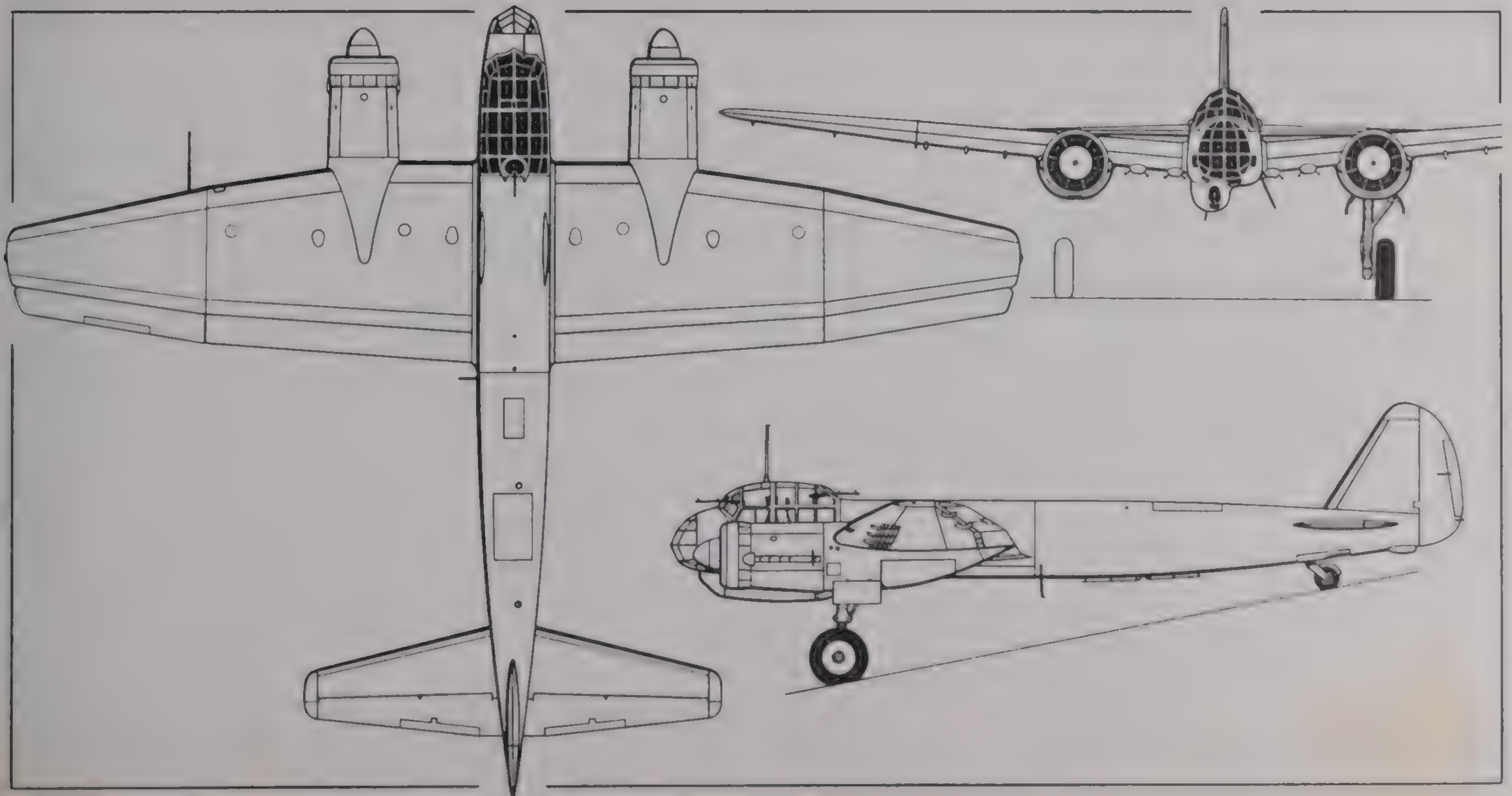
high-speed manoeuvres. All acrobatics were forbidden, and the crew's attention was drawn to the possibility of structural failure if the loading diagram was not strictly adhered to. Initially, defensive armament consisted of a single forward-firing 7.9-mm. MG 15 machine gun in the starboard side of the cockpit windscreen and operated by the pilot, and two similar weapons firing aft, one from the rear of the glazed upper cockpit decking and the other from the tail of the gondola beneath the nose. This was soon found to be inadequate and a second aft-firing MG 15 was hurriedly added, this being augmented by forward maintenance units which improvised mountings for a pair of lateral-firing MG 15s. However, as these weapons had each to be operated independently no great weight of fire could be brought to bear.

The first *Luftwaffe* unit to employ the Ju 88A-1 operation-

The Junkers Ju 88



Ju 88A-1 (4D + HH) of I./KG 30 "Adler", Aalborg, August





ally was the I Gruppe of *Kampfgeschwader* 30, a four-aircraft detachment of which operating from Westerland/Sylt on September 26, 1939 attacked a British naval force. The pilot of one of the Ju 88s, *Gefreiter* Carl Francke, believed that one of his two 1,102-lb. SC 500 bombs *might* have hit the carrier *Ark Royal*, and while the attack was, in fact, completely abortive, the German High Command report on the action issued the following day read: "Apart from the destruction of an aircraft carrier, a number of hits were scored on a battleship."

By May 10, 1940, all three *Gruppen* of KG 30 were opera-

(Left) Ju 88A-1s of KG 51, and (below) a Ju 88A of Stab of I/KG 30





(Above) Ju 88A-3s of a training unit, and (below) the 4th production Ju 88A-1

tional on the Ju 88A-1, together with two *Gruppen* of KG 51 and one *Gruppe* each of KG 4 and LG 1. These *Gruppen* played a relatively small part in the assault on France and the Low Countries, although Ju 88A-1s of LG 1 and KG 30 based at Düsseldorf did undertake a number of bombing sorties against shipping off Dunkirk on May 29th. However, the first major action in which the Junkers bomber was to participate was the Battle of Britain.

On *Adlertag* all three *Gruppen* of KG 51 had completed conversion to the Ju 88A, as had both *Gruppen* of LG 1, I and II *Gruppen* of KG 54, and III *Gruppe* of KG 1. For the assault on Britain *Luftflotte 2* included in its Order of Battle the Ju 88As of III/KG 1 under I *Fliegerkorps*, III/KG 4 under IX *Fliegerdivision*, the *Gruppen* of LG 1 under IV *Fliegerkorps*, and





A Ju 88A of I/KG 54. Two Gruppen of Kampfgeschwader 54 were deployed during the "Battle" under the V Fliegerkorps

the three Gruppen of KG 51 and two Gruppen of KG 54 under V Fliegerkorps.

Highlights of the activities of the Ju 88A during the battle included the mass attack of 63 Ju 88As from KG 51 and KG 54 on Portsmouth on August 12th, the day preceding *Adlertag*, with 15 aircraft detached to bomb radar installations at Ventnor, Isle of Wight, and, on August 15th, an unescorted attack by 50 Ju 88As from KG 30 on Driffild during which six of the bombers fell to the guns of R.A.F. fighters. On the same day, LG 1 based on Orleans despatched 12 Ju 88As of its I Gruppe against Middle Wallop and 15 from its II Gruppe against Worthy Down. The I Gruppe attack took the fighter base completely by surprise, and a number of Spitfires were destroyed on the ground, but only three aircraft of II Gruppe found their target and five of the bombers were lost during the operation.

The Ju 88A was undoubtedly the best of the *Luftwaffe* bombers participating in the Battle of Britain, and Gruppen

equipped with this type suffered lower attrition on operations than those employing other bomber types. It possessed an excellent performance, was manoeuvrable for its size, and could absorb considerable punishment. But it was deficient in both defensive armament and armour protection, and although some effort was expended during the battle in attempts to rectify these shortcomings, the Ju 88A was still considered relatively easy prey by R.A.F. fighter pilots when the Battle of Britain drew to a close.

Junkers Ju 88A-I Specification

Type:	Four-seat Medium Bomber.
Power Plants:	Two Junkers Jumo 211B-1 12-cylinder liquid-cooled engines each rated at 1,200 h.p. for take-off and 1,210 h.p. at 820 ft.
Performance:	Maximum speed (at 19,750 lb.), 280 m.p.h. at 18,050 ft., 272 m.p.h. at 19,685 ft., 227 m.p.h. at sea level (at 22,840 lb.), 258 m.p.h. at 18,050 ft., 250 m.p.h. at 19,685 ft.; normal cruising speed, 217 m.p.h. at 18,050 ft.; range, 620 mls., (with auxiliary tank in forward bomb-bay), 1,055 mls.; service ceiling at 19,750 lb., 26,250 ft.
Weights:	Empty equipped, 16,975 lb.; maximum loaded, 22,840 lb.
Armament:	(Defensive) One fixed or free-mounted 7.9-mm. MG 15 machine gun firing forward and two 7.9-mm. MG 15 machine guns on flexible mountings firing aft above and below the fuselage (later augmented by two lateral-firing MG 15s). (Offensive) Maximum of 28 110-lb. bombs in two internal bays and four 220-lb. bombs on external racks, or 10 110-lb. bombs in aft bay and four 551-lb. or two 1,102-lb. bombs externally.
Dimensions:	Span, 60 ft. 3½ in.; length, 47 ft. 1½ in.; height, 17 ft. 5½ in.; wing area, 565.1 sq. ft.

The Heinkel He 111

WHEN the first shots of World War Two were fired across the Polish border the Heinkel He 111 bomber was undoubtedly a formidable offensive weapon. An elegant, well-built and efficient aircraft with good flying characteristics, it was a thoroughbred inheriting its shapely contours from its single-engined predecessor, the He 70 *Blitz*. Created by Siegfried and Walter Günter, the He 111 temporarily placed Germany in the forefront of modern bomber development but was to suffer the misfortune of having to soldier on long past its allotted span owing to the inability of the German aircraft industry to produce a suitable replacement. Indeed, it was already approaching obsolescence when called upon to carry the major burden of the *Luftwaffe's* bombing offensive

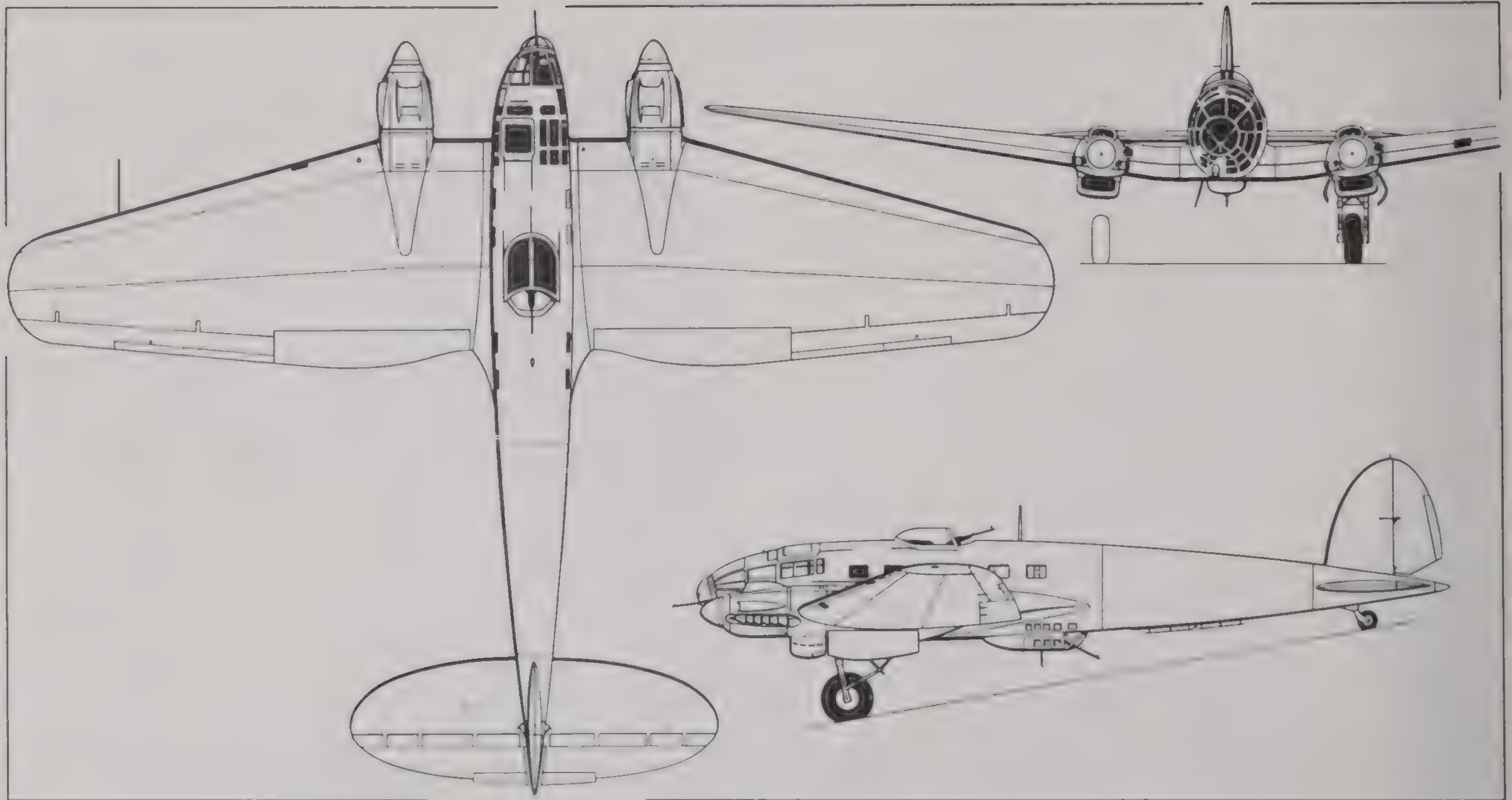
against the British Isles.

Like so many other German warplanes of its era, the He 111 was first revealed to the world in civil guise, and when shown to the press on January 10, 1936 at Tempelhof, Berlin, as a 10-passenger commercial transport, its slender, beautifully streamlined fuselage and low-drag elliptical wings were obviously designed for maximum performance, passenger comfort being a very secondary consideration and commercial operating economics being somewhat questionable. What was *not* revealed was the fact that the first prototype had flown as a bomber almost a year earlier, on February 24, 1935, with Gerhard Nitschke at the controls.

During the remainder of the 'thirties, the He 111 was



The Heinkel He 111



subjected to constant development until the models of the bomber with which the *Kampfgruppen* of the *Luftwaffe* were primarily equipped when hostilities began bore little more than a superficial resemblance to those that first entered service at Hannover-Langenhagen with *Kampfgeschwader 154* during the closing months of 1936. Immediately prior to World War Two the P- and H-series of the bomber had almost entirely supplanted all earlier versions of the He 111 with the first-line *Kampfgruppen*, and on September 1, 1939 the 808 bombers of this type of strength included 349 He 111Ps and 400 He 111Hs.

The two models differed from each other primarily in the type of power plant that they employed, the P-series having the Daimler-Benz DB 601A and the H-series having the Junkers Jumo 211. The production of both versions was planned simultaneously, but power plant availability dictated the service introduction of the He 111P some two months earlier than the He 111H. Subsequently production proceeded in parallel until early in 1940 when the decision to standardize on the Jumo 211 engine led to the phasing out of the He 111P.

One of the most distinctive features of the wartime He 111 bomber was its extensively glazed nose, the contours of

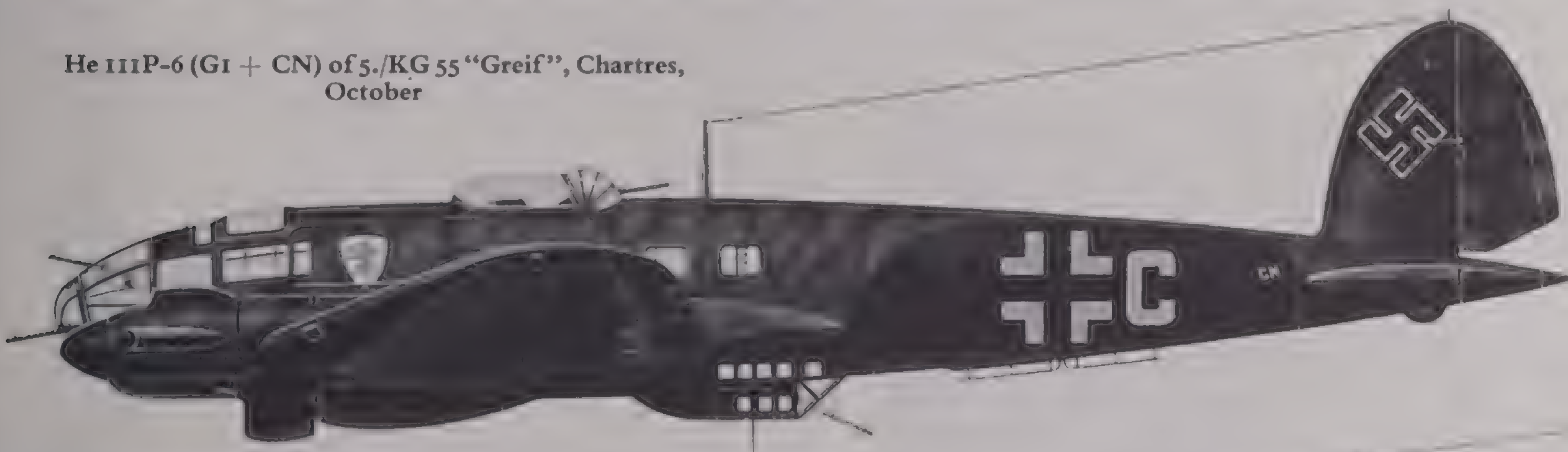
The Heinkel He 111

which were unbroken by a stepped pilot's windscreen. The pilot was seated to port, his instrument panel being attached to the glazed roof, and in order to provide him with the maximum possible view, the universal mounting for the nose gun was offset to starboard, resulting in the peculiar asymmetric effect that was to characterise the bomber. For landing in poor visibility the pilot could elevate his seat so that his head projected through a sliding panel, and in this position it was protected from the slipstream by a small retractable windscreen. This nose section offered the crew magnificent visibility, although when the sun was behind the aircraft the

curved transparent panels tended to emulate mirrors, seriously inconveniencing the pilot.

Deliveries of the He 111P-1 to the *Kampfgruppen* began in March 1939, being followed in May by the He 111H-1, the latter being identical to the He 111P-2 (which differed from the initial P-series model solely in the type of radio equipment installed) apart from its engines, and the performances of the two models were closely comparable. A 4,410-lb. bomb load could be carried, this being accommodated in vertical cells, four on each side of a central gangway, each of which could house a 551-lb. bomb. Defensive armament was con-

He 111P-6 (GI + CN) of 5./KG 55 "Greif", Chartres, October



He 111H-2 (A1 + ET) of 9./KG 53 "Condor", Lille-Nord, August





(Above) He 111H-2 of Stab/KG 53, and (below left) an He 111H-2 of II/KG 26 "Löwen"



finned to three 7.9-mm. MG 15 machine guns—one on an Ikaria spherical mounting in the glazed nose, one firing laterally or aft from the shielded dorsal position over the wing, and the other firing aft from a ventral gondola. Four crew members were normally carried.

Twenty-one *Gruppen* of the *Luftwaffe* were equipped with the He 111 when hostilities began. The Polish campaign revealed one major shortcoming—ineffective defensive armament. Possessing none of the power-operated turrets which characterised British medium bombers, the He 111's defensive armament had remained unaltered from the very first prototype, and was soon found to be woefully inadequate. Combat attrition of the He 111 formations over Poland, where fighter opposition was relatively weak and confined to obsolete PZL P.11 monoplanes, was markedly higher than had been anticipated by the High Command which had been deluded by the success of the lightly-armed He 111 over Spain, and measures were immediately taken to rectify the situation. The He 111P-2 was hurriedly supplanted on the assembly lines by the He 111P-4 which introduced some armour protection for the crew, an additional forward-firing MG 15 machine gun, and two MG 15 beam guns firing through side windows, a fifth crew member being introduced to operate these weapons. Some aircraft were even provided with a remotely-operated

The Heinkel He 111

7.9-mm. MG 17 gun in the tail cone to discourage attacks from directly aft.

Other changes included the blanking-off of the port bomb cells to provide space for supplementary fuel and oil tanks, and the provision of two PVC 1006 bomb carriers beneath the blanked-off bomb cells. A similar pair of carriers could be fitted beneath the starboard bomb cells if required. Simultaneously, the modifications introduced by the He 111P-4 were incorporated on the He 111H-2 assembly lines, this sub-type having initially differed from the He 111H-1 solely in having 1,100 h.p. Jumo 211A-3 engines in place of the original 1,010 h.p. Jumo 211A-1s. The He 111H-3, which made its début in November 1939, was intended for both normal bombing and anti-shipping operations, its concession to the latter role being the introduction of a single forward-firing 20-mm. MG FF cannon in the ventral gondola, although the effectiveness of this weapon was limited by the small traverse possible and relatively low rate of fire. Weight increases were catered for by the installation of Jumo 211D-1 engines offering 1,200 h.p. for take-off. An increase in power was also marked by the final production P-series sub-type, the He 111P-6, which received 1,175 h.p. DB 601N engines.

By *Adlertag* only four *Kampfgeschwader* were still completely equipped with the He 111, these being KG 26 which was still based in Norway, and KG 27, KG 53 and KG 55 based at Tours, Lille and Chartres respectively, other former He 111-equipped units having converted or being in process of conversion to the Ju 88A. After the initial strikes across the channel, the first sorties in force by He 111s took place on August 15th when 63 aircraft of I and III *Gruppen* of KG 26 flew from Stavanger escorted by Bf 110D fighters of I/ZG 76, their intention being to attack Dishforth and Linton-upon-Ouse. Owing to a navigational error none found its target and, intercepted by R.A.F. fighters, the two *Gruppen* suffered heavy losses.



(Above) An He 111H-2 of the Aufklärungsgruppe Ob.d.L., and
(below) He 111P-6s of KG 55 during the "Battle"





(Above and below) He 111Ps awaiting delivery to the Luftwaffe

Daylight attacks by the He 111 formations continued despite almost insupportable attrition. Although armour and defensive armament had been progressively improved since the Polish campaign, the He 111 was, nevertheless, the most vulnerable of the *Luftwaffe's* bombers. The provision of heavier escorts barely alleviated the situation, and on occasions



when the hard-pressed Bf 109E *Gruppen* failed to rendezvous with their charges, the He 111 formations were massacred. By mid-September it was obvious to the *Luftwaffe* that a change of tactics was imperative, and from the 16th of that month the Heinkel bomber was largely confined to nocturnal sorties.

Heinkel He 111P-4 Specification

Type:	Five-seat Medium Bomber.
Power Plants:	Two Daimler-Benz DB 601A-1 12-cylinder liquid-cooled engines each rated at 1,100 h.p. for take-off and 1,015 h.p. at 14,765 ft.
Performance:	(At 23,590 lb. with figures in parentheses relating to aircraft in maximum loaded condition) Maximum speed, 225 (176) m.p.h. at sea level, 242 (190) m.p.h. at 6,560 ft., 247 (200) m.p.h. at 16,400 ft.; cruising speed at 85% power, 194 (168) m.p.h. at sea level, 212 (180) m.p.h. at 6,560 ft., 232 (193) m.p.h. at 16,400 ft.; maximum range, 1,224 mls. at 9,840 ft., with overload fuel, 1,490 mls.; time to 3,280 ft. at 29,762 lb., 7 min., to 6,560 ft., 14.2 min.; service ceiling, 26,250 (14,765) ft.
Weights:	Empty, 14,936 lb.; empty equipped, 17,670 lb.; maximum loaded, 29,762 lb.
Armament:	(Defensive) One 7.9-mm. MG 15 machine gun on flexible spherical nose mounting, one fixed forward-firing 7.9-mm. MG 15, one 7.9-mm. MG 15 on free mounting firing from each of two beam windows, and one aft-firing 7.9-mm. MG 15 on free mounting at rear of dorsal position and ventral gondola. (Offensive) Four 551-lb. SC 250 bombs stowed vertically internally and one or two 1,102-lb. SC 500 bombs mounted externally.
Dimensions:	Span, 74 ft. 1 $\frac{3}{4}$ in.; length, 53 ft. 9 $\frac{1}{2}$ in.; height, 13 ft. 1 $\frac{1}{2}$ in.; wing area, 942.917 sq. ft.

The Dornier Do 17 and Do 215

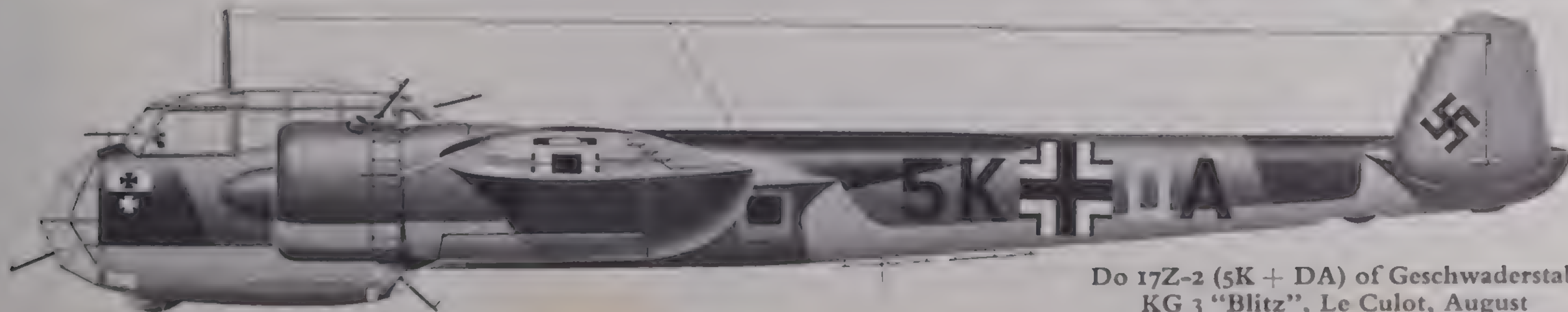
IN the mid 'thirties the first rumours of the existence of a very fast and efficient *Schulterdecker-Kampfflugzeug* in Germany began to percolate through the British and French air ministries; a graceful shoulder-wing bomber allegedly faster than any single-seat fighter extant. Confirmation of the existence of this advanced warplane came in October 1935 when one of the prototypes was demonstrated at Bückeburg, but it was not until nearly two years later, in July 1937, when an example of this bomber participating in the International Military Aircraft Competition at Zürich-Dübendorf won the "Circuit of the Alps", that the existence of the Dornier Do 17 became common knowledge. So slim was the new bomber in side elevation that it was promptly dubbed the "Flying Pencil", an unofficial appellation that it was to retain throughout its career, despite the loss of the pencil-like contours by

the variants most widely used during the course of the Battle of Britain.

The Do 17 had been evolved at a time when the theories of air strategy prevalent in Germany relegated the fighter to a secondary role, the bomber possessing sufficient speed to elude interceptors. Although this was to prove a fallacy, the theory was reinforced by the début of the Do 17. The first of three prototypes had flown in the autumn of 1934 but was intended as the progenitor of a six-passenger high-speed commercial transport suitable for use on European express services by the national German airline, Deutsche Lufthansa. Rejected by the airline, it was purely fortuitous that the Do 17 was further developed as a bomber, and the second bomber prototype revealed a maximum level speed of 243 m.p.h. at a time when the R.A.F. was just introducing the Gloster



Do 17P-1 (5F + RM) of 4.(F)/14 "Münchhausen Staffel", Cherbourg, September



Do 17Z-2 (5K + DA) of Geschwaderstab KG 3 "Blitz", Le Culot, August

The Dornier Do 17 and Do 215

Gauntlet fighter barely capable of reaching 230 m.p.h.

The genealogical processes that carried the Do 17 to the



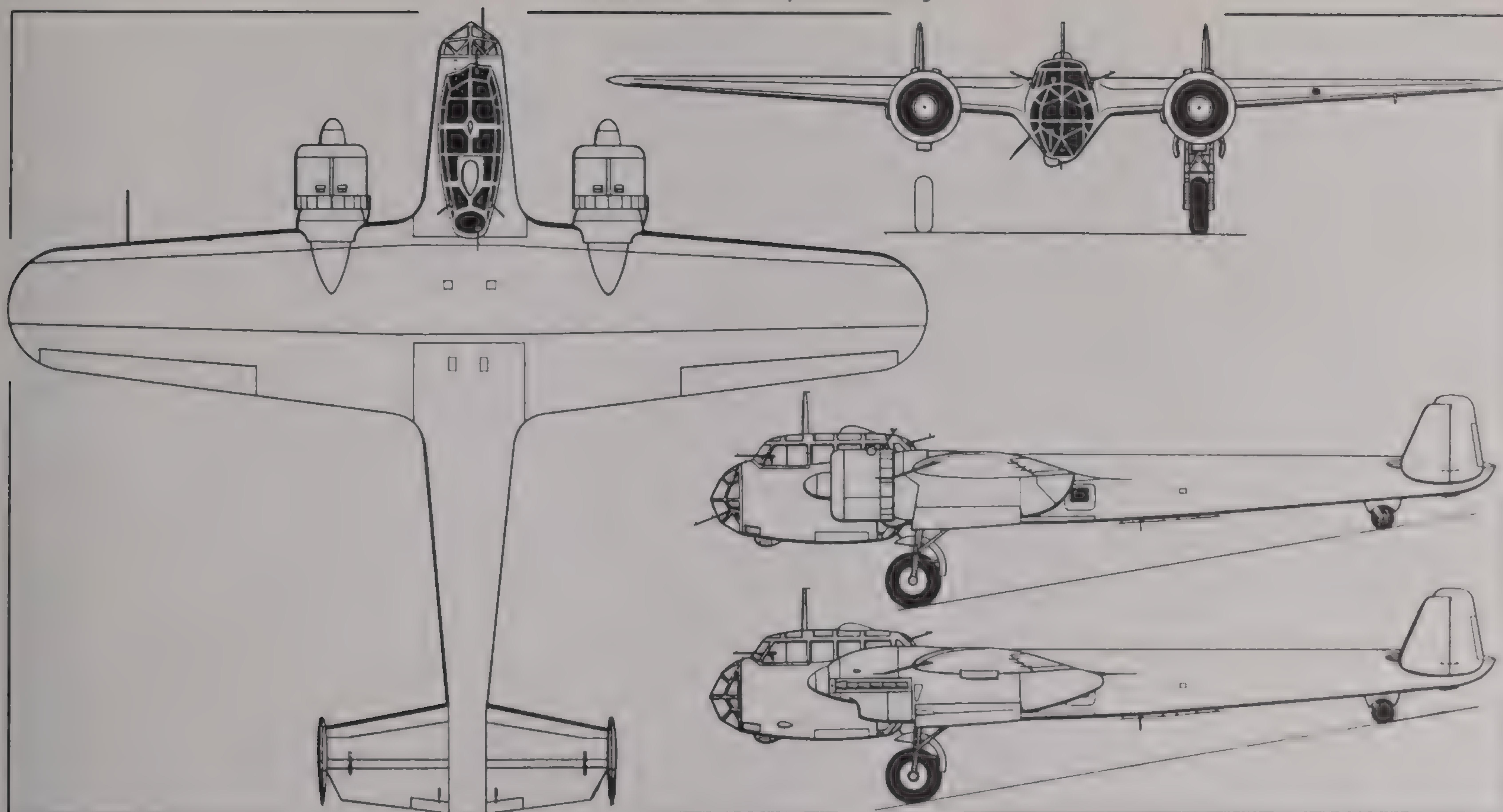
apex of its development were, like those of its contemporary, the He 111, somewhat complex, and during its pre-war years of *Luftwaffe* service it underwent a number of power plant and equipment changes until, early in 1939, the *Kampfgruppen* began to receive a markedly improved development of the basic design, the Do 17Z, the redesigned forward fuselage of which drastically altered the appearance of the bomber.

During the Spanish Civil War it had become obvious that the underside of the Do 17 was inadequately protected. The downward-firing 7.9-mm. MG 15 machine gun poked

(Above left) A Do 17Z-2 of KG 3 "Blitz", and (below) a Do 17Z-2 of the Geschwaderstab of KG 2



The Dornier Do 17 and Do 215



through a hatch in the floor had too limited a field of fire, and to overcome this problem the new forward fuselage owed everything to the dictates of operational efficiency and nothing to aerodynamic refinement. Crew accommodation provided by the Do 17 had always been too confined for maximum operational efficiency, and thus the cockpit roof was raised and fully glazed, and the nose containing the bombardier's station was also fully glazed with a series of small flat panels, the lower portion being bulged and extended aft to a point just forward of the wing leading edge, terminating in a position for a rearward- and downward-firing MG 15

A Do 17P-1 reconnaissance aircraft, one of the predecessors of the Do 17Z and used in small numbers during the "Battle"



The Dornier Do 17 and Do 215

machine gun.

The first major production variant to embody this redesign, the Do 17Z, appeared late in 1938 as a four-seat bomber.



Armament remained three 7.9-mm. MG 15 machine guns—one on a pillar-type mounting at the rear of the flight deck, a second protruding through the starboard panels of the windscreen, and the third firing from a hemispherical mounting below the fuselage—but this was subsequently augmented by a fourth MG 15 protruding through the nose cone. The Do 17Z retained the good handling qualities and manoeuvrability of earlier Do 17 models; but with a crew of four, the increased armament and equipment, and a full 2,205-lb. bomb load, the Do 17Z-1 with two Bramo Fafnir 323A-1 radial engines each affording only 900 h.p. for take-off was decidedly underpowered. Accordingly, bomb load was reduced to 1,100 lb. but was restored to 2,205 lb. early in 1939 with the appearance of the Do 17Z-2 equipped with Bramo Fafnir 323P engines offering 1,000 h.p. for take-off.

(Above left) An early production Do 17Z-1, and (below) a Do 17Z-3 of 10./KG 2





Foreign interest in the Do 17Z had meanwhile crystallised in the form of orders for a version powered by Daimler-Benz DB 601A liquid-cooled engines, this being allocated the export designation Do 215A. Production against a Swedish contract for 18 Do 215A-1 bombers began late in 1939, but before deliveries could be effected an embargo was placed on export of the bomber, and those on the assembly line were adapted for long-range reconnaissance tasks with the *Luftwaffe* as the Do 215B.

On September 1, 1939, the nine *Kampfgruppen* of KG 2, KG 3, KG 76 and KG 77 equipped with Do 17s possessed a first-line strength of 370 aircraft of which 212 were Do 17Zs. Few of the earlier versions of the Do 17 remained on the strength of the *Kampfgruppen* when the first skirmishes of the Battle of Britain took place, but the Do 17Z-2 was in the forefront when the first attacks on channel convoys took place in

July 1940. The *Kommodore* of KG 2, *Oberst* Fink, was given the title of *Kanalkampfführer* (Channel Battle Leader) and entrusted with the task of clearing the channel with a battle group of which the principal component was the Do 17Z-2s of his own KG 2. Numerous attacks were made on Allied

(Above) A Do 215B-1 and (below) a Do 215B-0. This DB 601-powered version of the Do 17Z appeared in small numbers during the "Battle"





A Do 17Z-2 of the Geschwaderstab of KG 3

Dornier Do 17Z-2 Specification

Type:	Four-seat Medium Bomber.
Power Plants:	Two Bramo Fafnir 323P nine-cylinder radial air-cooled engines each rated at 1,000 h.p. for take-off and 940 h.p. at 13,120 ft.
Performance:	(At maximum loaded weight) Maximum speed, 186 m.p.h. at sea level, 224 m.p.h. at 13,120 ft., (at 17,730 lb.), 214 m.p.h. at sea level, 255 m.p.h. at 13,120 ft.; cruising speed (at maximum loaded weight), 168 m.p.h. at sea level, 186 m.p.h. at 13,120 ft.; tactical radius with standard fuel and 2,205-lb. bomb load, 205 mls.; maximum range with auxiliary fuel tank and 1,100-lb. bomb load, 720 mls.; service ceiling (at 18,832 lb.), 22,965 ft., (at 17,730 lb.), 26,900 ft.
Weights:	Empty, 11,484 lb.; empty equipped, 12,958-13,145 lb.; maximum loaded, 18,931 lb.
Armament:	(Defensive) Two fixed or free-mounted forward-firing 7.9-mm. MG 15 machine guns, two free-mounted 7.9-mm. MG 15 machine guns firing aft, one above and one below the fuselage, and (field modification) two free-mounted 7.9-mm. MG 15 machine guns firing from side windows. (Offensive) Maximum internal bomb load of 2,205 lb., typical loads including 20 110-lb. SD 50 or four 551-lb. SD 250 bombs.
Dimensions:	Span, 59 ft. 0½ in.; length, 51 ft. 9½ in.; height, 14 ft. 11½ in.; wing area, 592.014 sq. ft.

shipping, and on *Adlertag* the Do 17Z-2s of KG 2 bombed Eastchurch as the sole *Kampfgeschwader* which failed to receive Göring's postponement order, losing four of its aircraft in the process.

Two days later the Do 17Z-2s of KG 3 bombed Eastchurch and Rochester, and on the 16th those of KG 76 attacked West Mallory, also attacking Kenley and Biggin Hill on the 18th. The Do 17Z was popular with both flying and ground personnel, being considered the most reliable of the *Luftwaffe's* bombers, but it lacked the load-carrying capability of the He 111 and the speed of the Ju 88A. However, it was relatively manoeuvrable and was able to undertake shallow diving attacks at speeds exceeding 370 m.p.h. thanks to its high structural strength. It was certainly the most successful of the *Luftwaffe* bombers participating in the Battle of Britain in evading R.A.F. fighters. The Do 17Z formations specialised in low-level, terrain-following attacks, making maximum use of the element of surprise, but the numerical importance of this type in the *Luftwaffe's* Order of Battle was already dwindling before the conflict over Britain was joined in earnest.

The Daimler-Benz DB 601-powered version of the Do 17Z, the Do 215B, appeared over the British Isles in small numbers, being used primarily for strategic reconnaissance by the *Luftwaffe* High Command's special reconnaissance *Gruppe*. The principal sub-type, the Do 215B-4, had an Rb 50/30 camera mounted beneath the lower gun position and an Rb 20/30 camera beneath the crew entry hatch. For combined bombing and reconnaissance missions five 110-lb. bombs were normally carried, but up to 10 of these missiles could be carried for short-range missions.

The end of the Battle of Britain also signified the end of large-scale use of the Do 17 by the *Luftwaffe* for within six months only one *Kampfgeschwader* equipped exclusively with the Do 17Z remained in the Order of Battle.



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